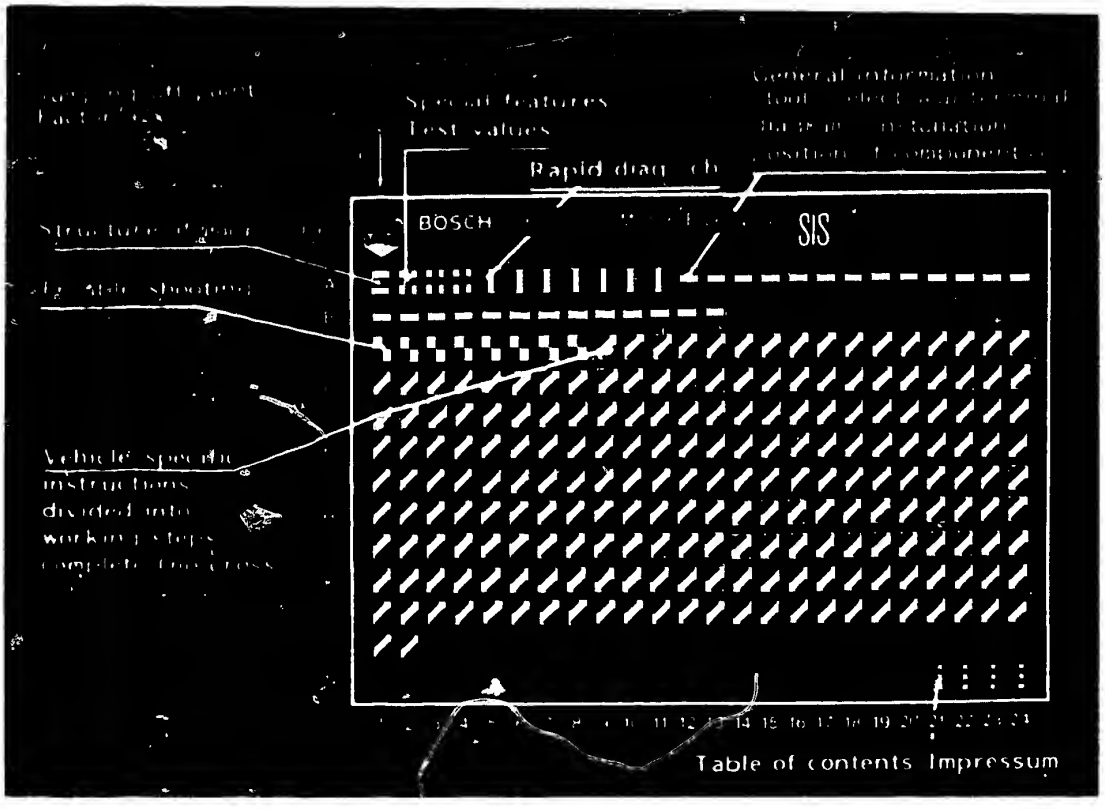
Structure of microfiche



1. Read from left to right
2. Title of microfiche (appears on each coordinate)

E16	Product/component/test step Vehicle/engine

Coordinate

3. Limits of section

Beginning	Mid-section	End	One-page section

4. Purely vehicle-specific passages in the text are marked with a vertical bar.

5. Reference to relevant working steps in the test specifications, e.g. coordinate C6.

C6

1. Special features

- Closed-loop-controlled exhaust-gas recirculation (EGR)
- Duration-of-injection signal (SD)
- Exhaust turbo-supercharger

  Engine types: XD 2 S - 2.3 l
  XD 3 T - 2.5 l

2. Test specifications

2.1	Idle speed:	800...860 min^{-1}	D10
	vehicles with air conditioner (engine XD 2S-2.3 l only)	780...840 min^{-1}	
	Fast idle (engine XD 2S-2.3 l)	1100...1200 min^{-1}	
	Fast idle (engine XD 3T-2.5 l)	1050...1150 min^{-1}	
2.2	Nozzle-opening pressure:	150 + 5 bar	D16
2.3	Filter test max. permissible differential pressure:	0.3 bar	E3
2.4	Pressure drop	max. permiss. 25%	H15
2.5	Cold-start device (engine XD 2S-2.3 l only)		
	Cut-off at coolant temperature of	13°...18°C	
	Cut-in at coolant temperature of	8°...13°C	
2.6	Coordination, pump - engine (injection timing):		L5
2.6.1	Engine XD 2S - 2.3 l Automatic trans.		
	Test value	Cylinder 4	
	Engine position:	0.49...0.53 mm before TDC	
	Setting	Cylinder 4	
	Engine position:	0.51 mm before TDC	

	Test value Pump position:	0.48...0.52 mm after BDC
	Setting Pump position:	0.50 mm after BDC

2.6.2 Engine XD 3T - 2.5 l

L5

	Test value Engine position:	Cylinder 4 0.87...0.91 mm before TDC
	Setting Engine position:	Cylinder 4 0.89 mm before TDC
	Test value Pump position:	0.48...0.52 mm after BDC
	Setting Pump position:	0.50 mm after BDC

2.6.3 Engine XD 3T - 2.5 l Automatic trans.

L5

	Test value Engine position:	Cylinder 4 0.55...0.59 mm before TDC
	Setting Engine position:	Cylinder 4 0.57 mm before TDC
	Test value Pump position:	0.48...0.52 mm after BDC
	Setting Pump position:	0.50 mm after BDC

2.7	Charge-air pressure:	0.4...0.6 bar (engine XD 2S-2.3 l) 0.6...0.8 bar (engine XD 3T-2.5 l)

L19

2.8	Compression:	25 ... 30 bar
	Max. error between cylinders	5 bar

H15

2.9 Tightening torques

Fuel lines	25 Nm
Fastening screws for fuel-injection pump	20 Nm
Fastening screws for nozzle holder assemblies	70 Nm
Sheathed-element glow plugs	25 Nm
Support bracket for the fuel-injection pump	20 Nm
Screw plug	15 Nm
Setting screw-rocker arm	15 Nm
Fastening nut for the crankshaft pulley	170 Nm
Cylinder head cover screws	7.5 Nm

3. Rapid diagnosis chart for closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal with test adapter ETT 018.01, system test lead 1 684 463 166 and suitable multimeter:

The following rapid diagnosis chart makes it possible for the experienced diesel expert to quickly check the electric/electronic peripheral and control-unit functions.

If detailed information with regard to trouble detection and test procedure is required, always proceed following the trouble-shooting chart (beginning with coordinate E 14).

The rapid diagnosis chart contains the following details:

- Test step sequence
- Position of the V- and Ω-program-selector switches
- Remarks with regard to the operation of the universal test adapter or other components
- Test specifications for mulitmeter
- Details of the coordinates of the respective, detailed test program and trouble-shooting program.

Test instructions:
Disconnect or connect the control-unit plug only when the ignition is switched off.

Rapid diagnosis chart for universal test adapter ETT 018.01

Testing the closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal

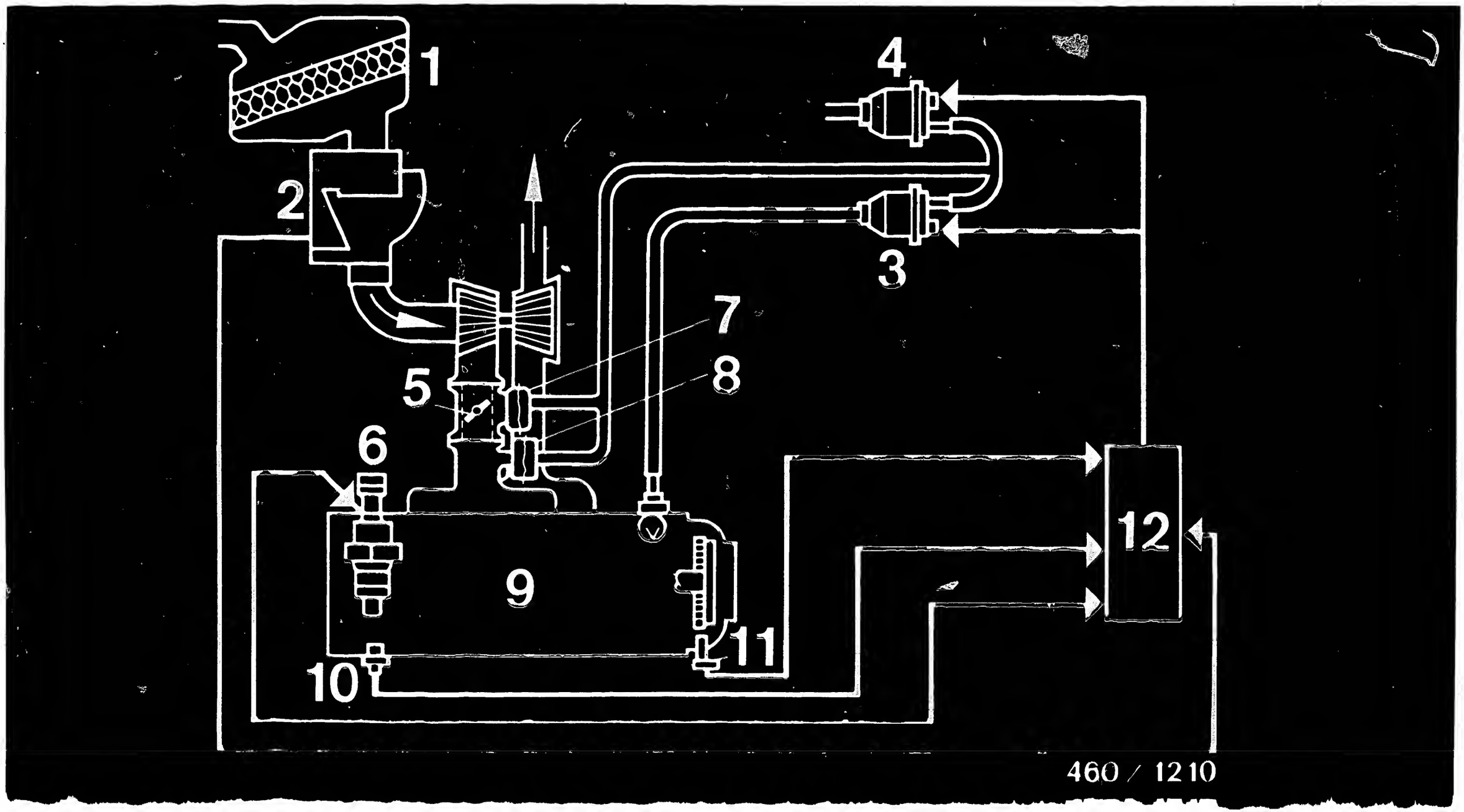
Test step	Switch position V	Switch position Ω	Button	Under test	Test connections	Test conditions	Test specifications (reading)	See coordinates for trouble-shooting
1	↓	1	--	Engine-speed sensor, short circuit to ground	1 - 4	Disconnect control-unit plug	∞ Ω	E 19
2	↓	2	--	Needle-movement sensor, short circuit to ground	2 - 4	Control-unit plug disconnected	∞ Ω	E 21
3	↓	3	--	Engine-speed sensor, internal resistance	1 -14	Control-unit plug disconnected	55...65 Ω	E 23
4	↓	4	--	Needle-movement sensor, internal resistance	2 -15	Control-unit plug disconnected	approx.20°C: 90...110Ω approx.80°C: 111...135Ω	F 1
5	↓	5	Btn 1 / Btn 2	Temperature sensor	16- 4	Control-unit plug disconnected	Engine cold:∞ Ω / Engine warm: 0...10Ω	F 3
6	↓	6	--	Ground terminal, control unit	11- 4	Control-unit plug disconnected	0 ... 10 Ω	F 5
7	↓	7	--	Atmosphere solenoid-operated valve - short circuit to ground	25- 4	Control-unit plug disconnected	∞ Ω	F 7

Rapid diagnosis chart for universal test adapter

Test step	Switch position V	Switch position Ω	Button	Under test	Test connections	Test conditions	Test specifications (reading)	See coordinates for trouble-shooting
8	↓	8	--	Vacuum solenoid-operated valve - short circuit to ground	13 - 4	Control-unit plug disconnected	∞ Ω	F 9
9	↓	16	--	Atmosphere solenoid-operated valve - internal resistance	25 - 12	Control-unit plug disconnected	24 ... 30 Ω	F 11
10	↓	17	--	Vacuum solenoid-operated valve - internal resistance	13 - 12	Control-unit plug disconnected	24 ... 30 Ω	F 13
11	1	--	--	Engine-speed sensor voltage	1 - 14	Connect control unit. Switch on ignition. Start engine and operate at idle speed.	2.70...4.70 V	F 15
12	2	--	--	Needle-movement sensor voltage	2 - 15	As test step 11	2.5 ... 6.0 V	F 17
13	4	--	--	Control-unit voltage U_{QK}	5 - 4	Note: Test step possible only for vehicle with XD 2S - 2.3 l engine, as test step 11	1.3...2.6 V	F 19

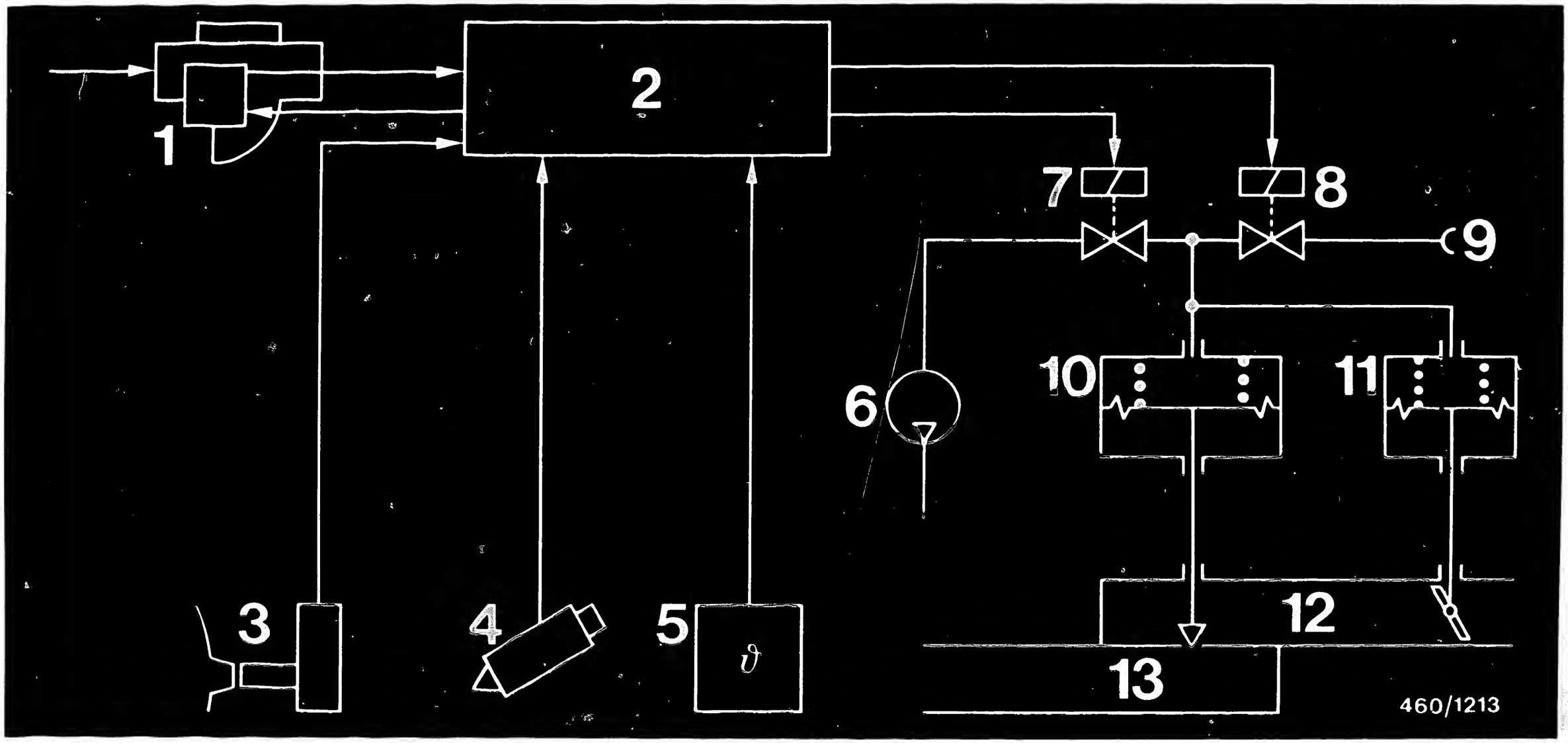
Rapid diagnosis chart for universal test adapter ETT 018.01

Test step	Switch positions V	Switch positions Ω	Button	Under test	Test connect-ions	Test conditions	Test specifications (reading)	See coordinates for trouble-shooting
14	6	--	--	Battery voltage	8 - 4	Connect control unit. Switch on ignition. Start engine and run at idle speed.	11.5...14.5 V	F 21
15	7	--	--	Battery voltage	12 - 4	As test step 14	11.5...14.5 V	F 23
16	8	--	--	Battery voltage	24 - 4	As test step 14	11.5...14.5 V	G 1
17	10	--	--	Air-flow sensor, power supply	10 - 4	As test step 14	1.3...2.0 V	G 3
18	11	--	Btn 5	Air-flow sensor voltage	22 - 4	As test step 14		
18/1			Btn 6			without btn actuation	307...411 mV	G 5
						with btn actuation	270...680 mV	G 7
19	12	--	Btn 6	Operation of EGR valve	25 - 4	As test step 14	Valve closed	G 9
20	13	--	Btn 5	Operation of EGR valve	13 - 4	As test step 14	Valve open	G 11
21	--	--	--	Operation of altitude switch		Note: Test step possible only for vehicle with XD 3T - 2.5 l engine Switch off ignition. Disconnect plug from altitude switch. Connect multimeter to term. 1 and term. 3.	≤ 880 mbar = 475...525 Ω ≥ 930 mbar = ∞ Ω	G 13



4. System circuit diagram of closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal

1 = Air filter
2 = Air-flow sensor
3 = Vacuum solenoid-operated valve
4 = Atmosphere solenoid-operated valve
5 = Throttle valve
6 = Injection nozzle with needle-movement sensor
7 = Throttle-valve vacuum unit
8 = EGR valve
9 = Vacuum pump (engine)
10 = Temperature sensor
11 = Engine-speed sensor
12 = Control unit



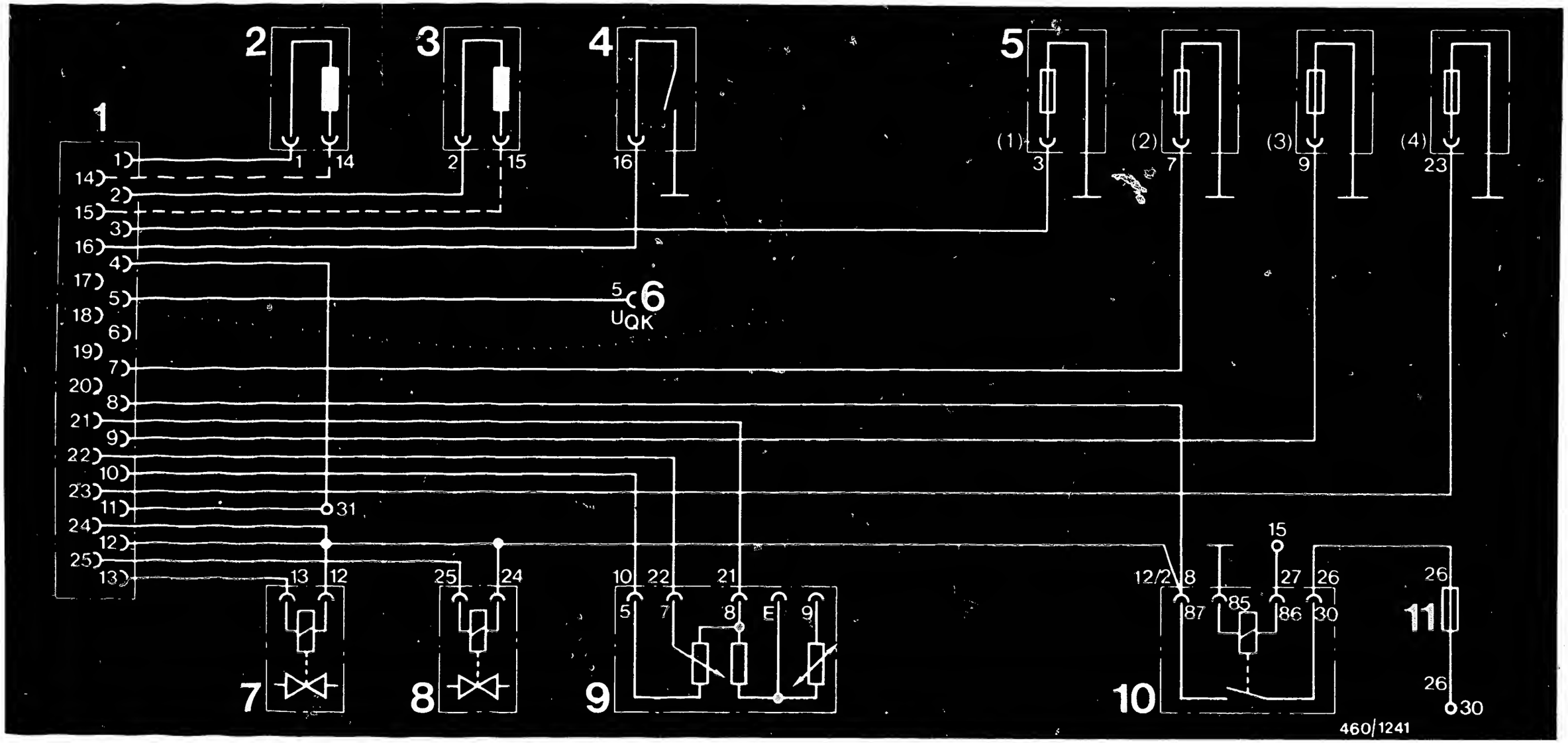
4.1 Block diagram of closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal

1 = Air-flow sensor
2 = Control unit
3 = Engine-speed sensor
4 = Injection nozzle with needle-movement sensor
5 = Temperature sensor
6 = Vacuum pump (engine)
7 = Vacuum solenoid-operated valve
8 = Atmosphere solenoid-operated valve
9 = Atmosphere connection
10 = Exhaust-gas recirculation valve
11 = Throttle-valve assembly
12 = Charge-air pipe
13 = Exhaust pipe

4.2 Function table of closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal

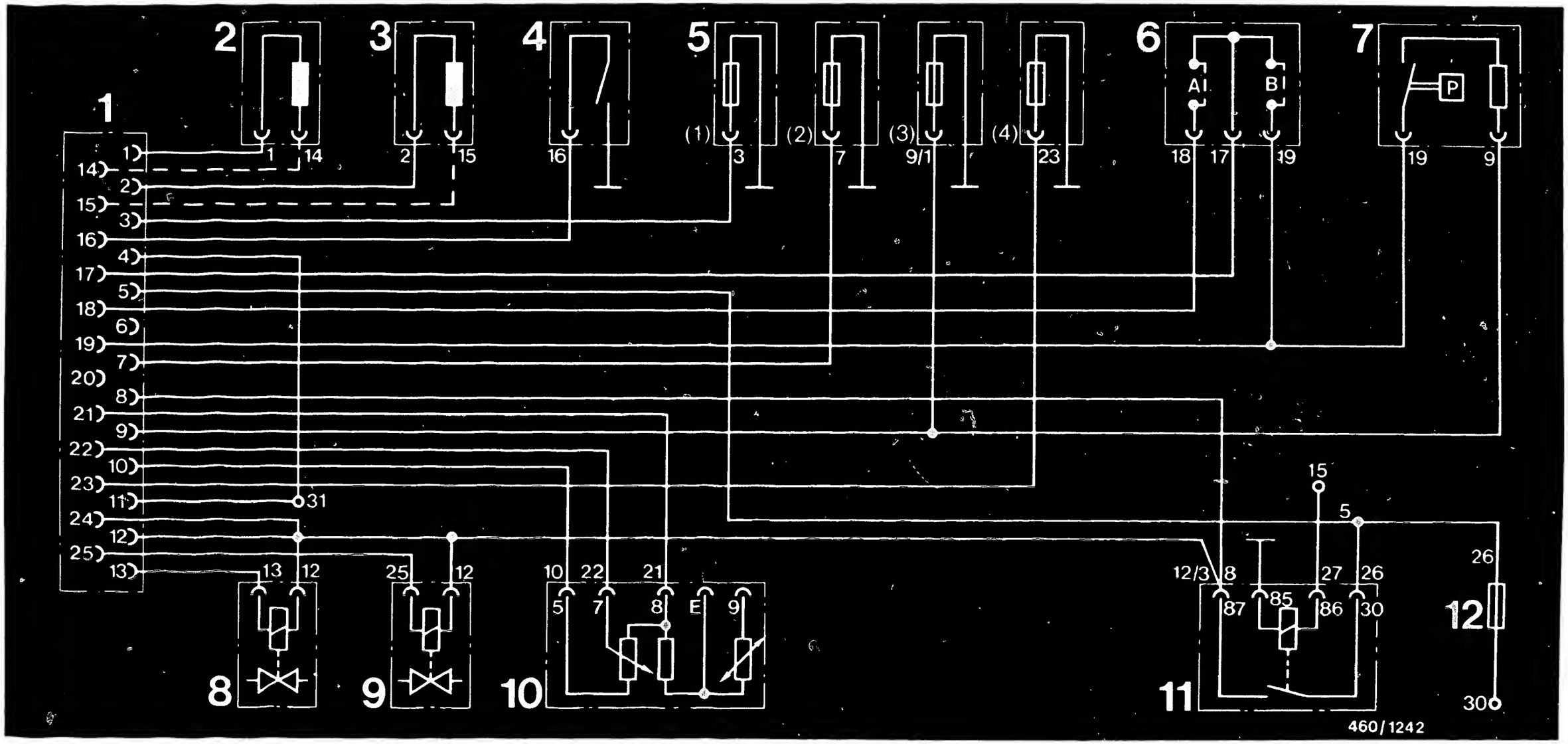
	Rising EGR rate	Falling EGR rate	No EGR	Stabilized control
Exhaust-gas recirculation	Yes Tendency rising	Yes Tendency falling	No	-
Solenoid-operated valve (vacuum)	Energized	De-energized	De-energized	De-energized
Solenoid-operated valve (atmosphere)	De-energized	Energized	Energized	De-energized
Throttle valve	Closing Tendency falling	Opening Tendency rising	Open	Half-closed at equilibrium
EGR valve	Opening Tendency rising	Closing Tendency falling	Closed	Half-open at equilibrium

The working range of the exhaust-gas recirculation system is limited to the following operating conditions: water temperature > 48°C and engine speed 600...3000 min^{-1}.



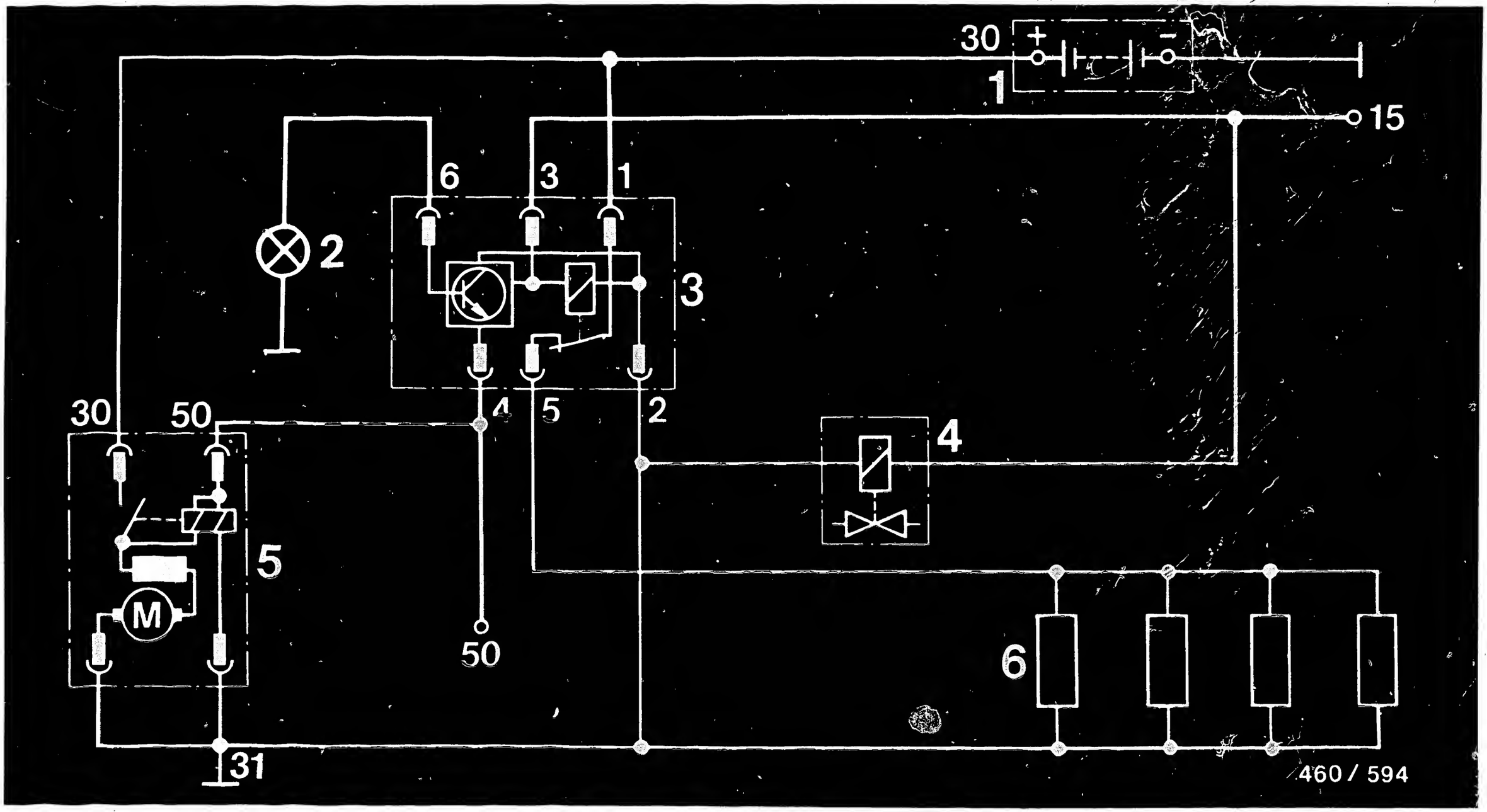
5. Electrical terminal diagram for closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal - engine XD 2S - 2.3 l

1 = Control-unit plug
2 = Engine-speed sensor
3 = Needle-movement sensor
4 = Temperature sensor
5 = Fuses (running-time electronics)
6 = Measuring output U_{QK} (for engine XD 2S - 2.3 l only)
7 = Vacuum solenoid-operated valve
8 = Atmosphere solenoid-operated valve
9 = Air-flow sensor
10 = Power-supply relay
11 = Fuse



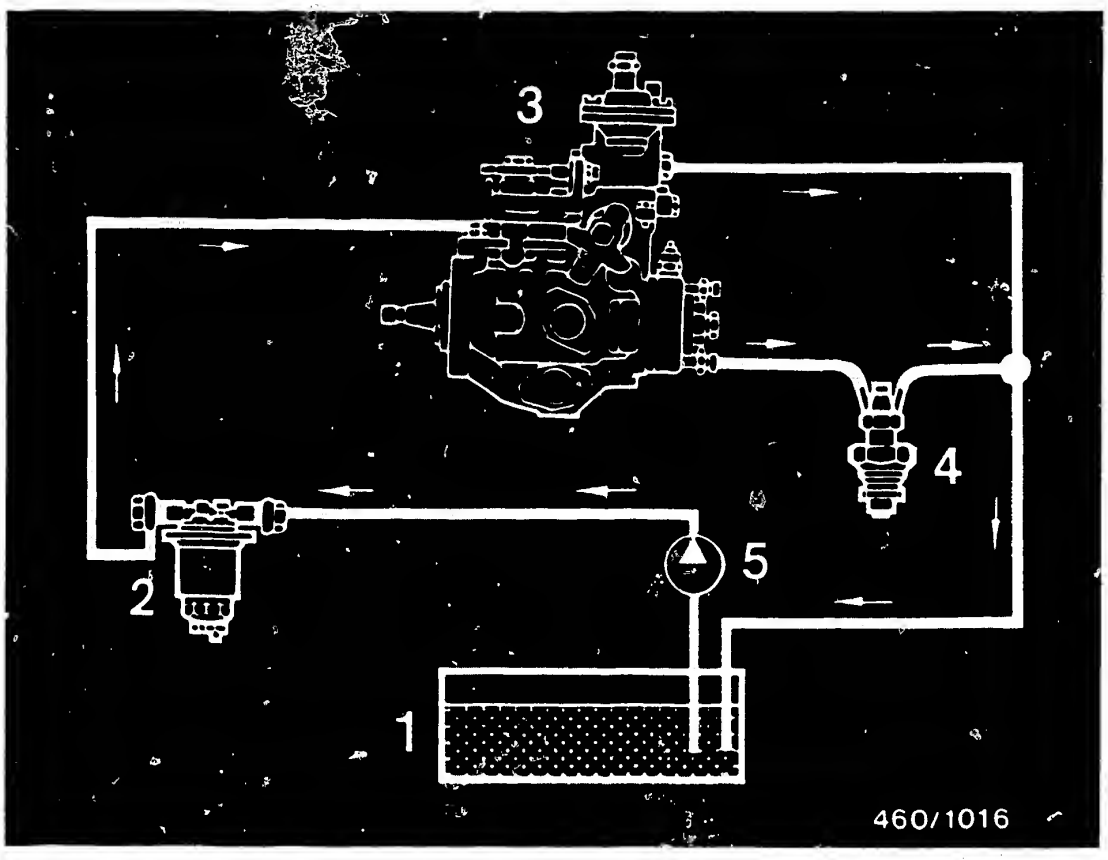
5.1 Electrical terminal diagram for closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal - engine XD 3T - 2.5 l

1 = Control-unit plug
2 = Engine-speed sensor
3 = Needle-movement sensor
4 = Temperature sensor
5 = Fuses (running-time electronics)
6 = Correction plug
7 = Altitude correction
8 = Vacuum solenoid-operated valve
9 = Atmosphere solenoid-operated valve
10 = Air-flow sensor
11 = Relay
12 = Fuse



6. Terminal diagram for preheating system

1 = Battery
2 = Glow-plug indicator lamp (12 V max. 2 W)
3 = Glow-duration unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Glow plugs

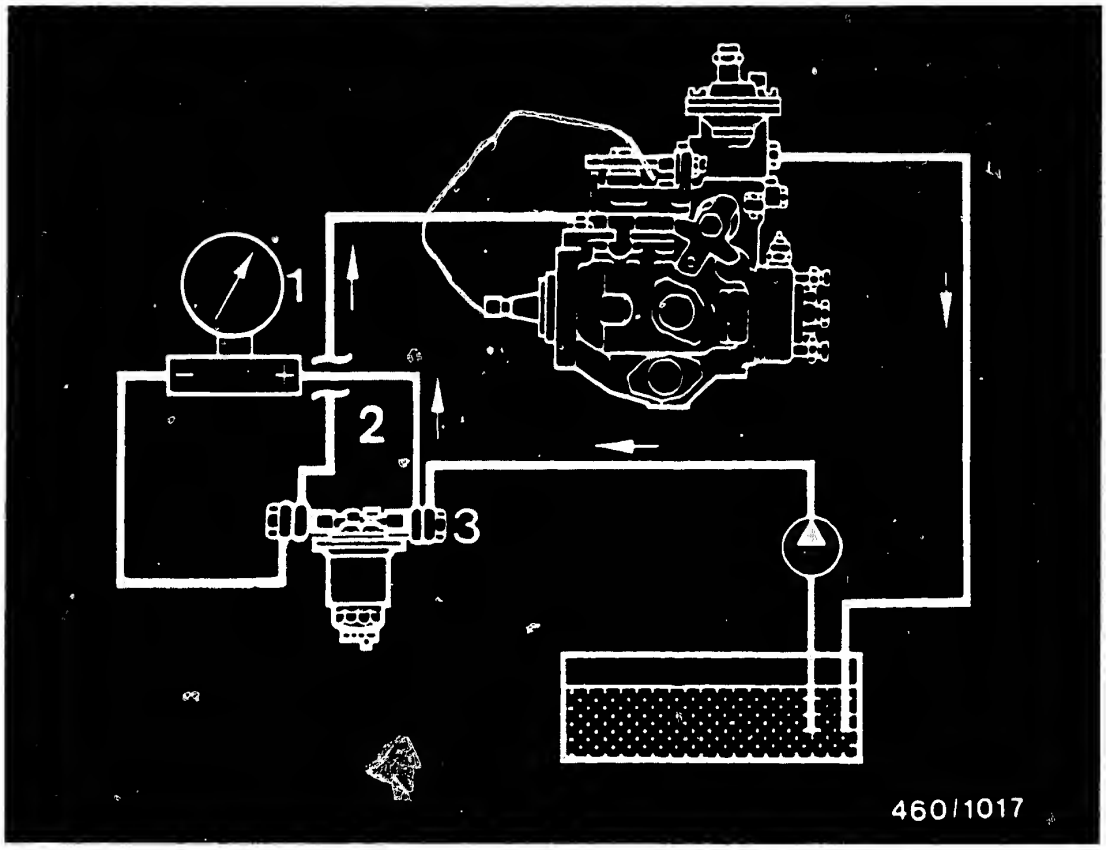


1 = Fuel tank
2 = Fuel filter
3 = Distributor-type fuel-injection pump
4 = Fuel-injection nozzles

7. Fuel line diagram

The fuel lines are connected as shown in the diagram above.

The fuel flows in the direction shown by the arrow.



1 = Differential pressure gauge
2 = Filter outlet
(Use inlet union and overlong inlet-union screw 2 443 456 020.)
3 = Filter inlet
(Use inlet union and overlong inlet-union screw 2 443 456 020.)

7.1 Connection diagram for filter test

Connect the differential pressure gauge to the fuel filter using appropriate connectors.

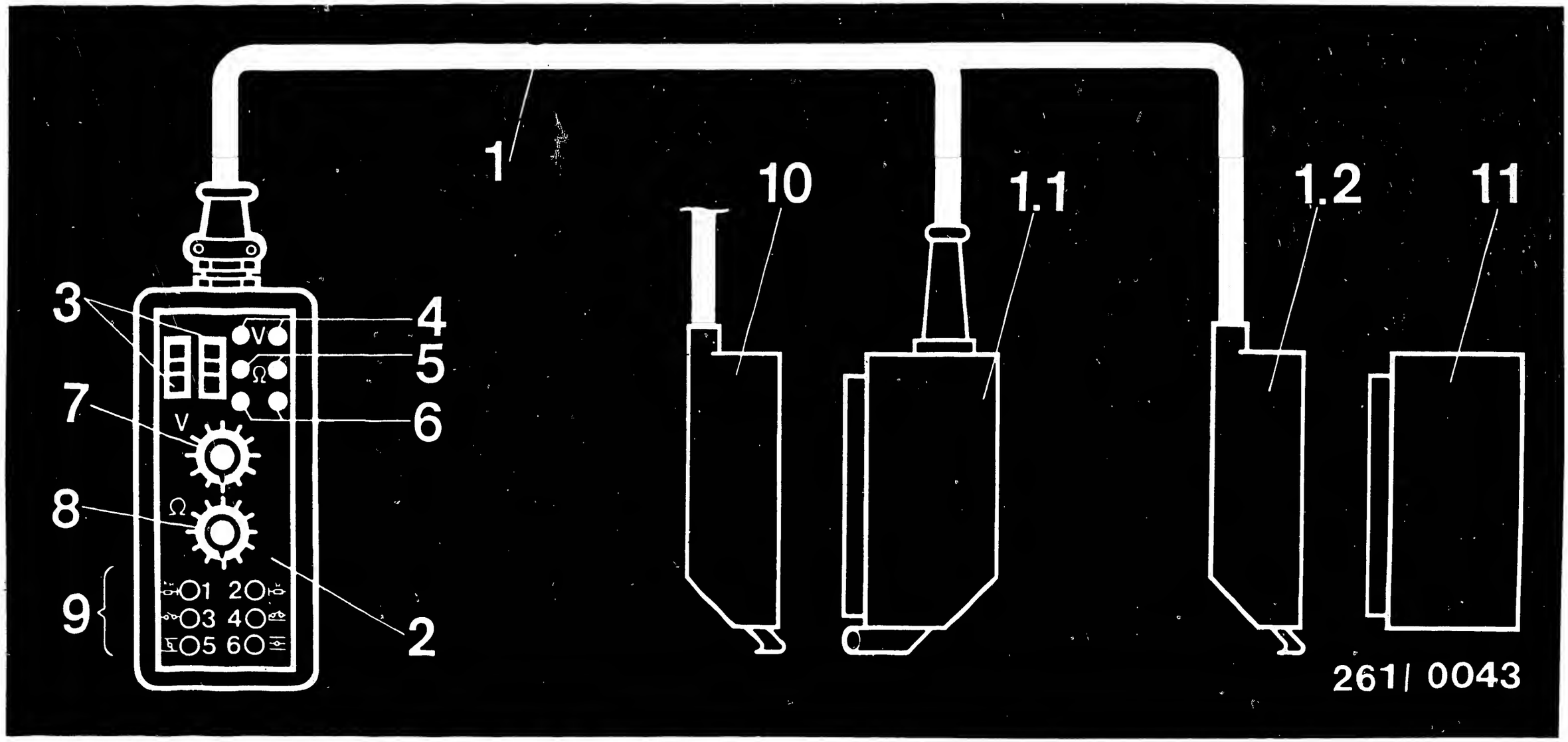
8. Test equipment and tools

Designation	Part No.	Use
Peugeot tool	8.0105 Y	Removing the valve springs (engine)
Pressure tester or pressure gauge 0 ... 1.6 bar	KDJE-P 100 e.g., Wika No. 4 184	Checking charge-air pressure
Box wrench	KDEP 1115	Releasing or tightening fuel-injection lines
Measuring tool	KDEP 2991	Injection timing
Measuring tool	KDEP 1085	Injection timing
Adapter for measuring tool	KDEP 1127	Injection timing
Mini dial indicator graduation 1/100 mm	commercially available, e.g., Hahn & Kolb D-7000 Stuttgart Part No. 33 003	Injection timing

Designation	Part No.	Use
Nozzle tester	EFEP 60 H 0 681 200 502	Checking fuel-injection nozzles
Compression tester	commercially available	Checking engine compression
Compression loss tester	EFAW 210 A 0 681 001 901	Checking engine compression loss
Tachometer	commercially available,e.g., Dr.E. Horn GmbH Meßgerätefabrik Postfach 40 D-7036 Schönaich Part Des.: HT 446 (with digital display)	Adjusting engine speed
Differential pressure gauge	commercially available, Part No. NG 160/311-911 -1.0 + 4.0 bar Haenni Nauheimer Str. 78 - 80 D-7000 Stuttgart 50	Filter test
Evaluation unit accessary box, with metering device	0 684 102 050 0 681 169 038	Exhaust gas test

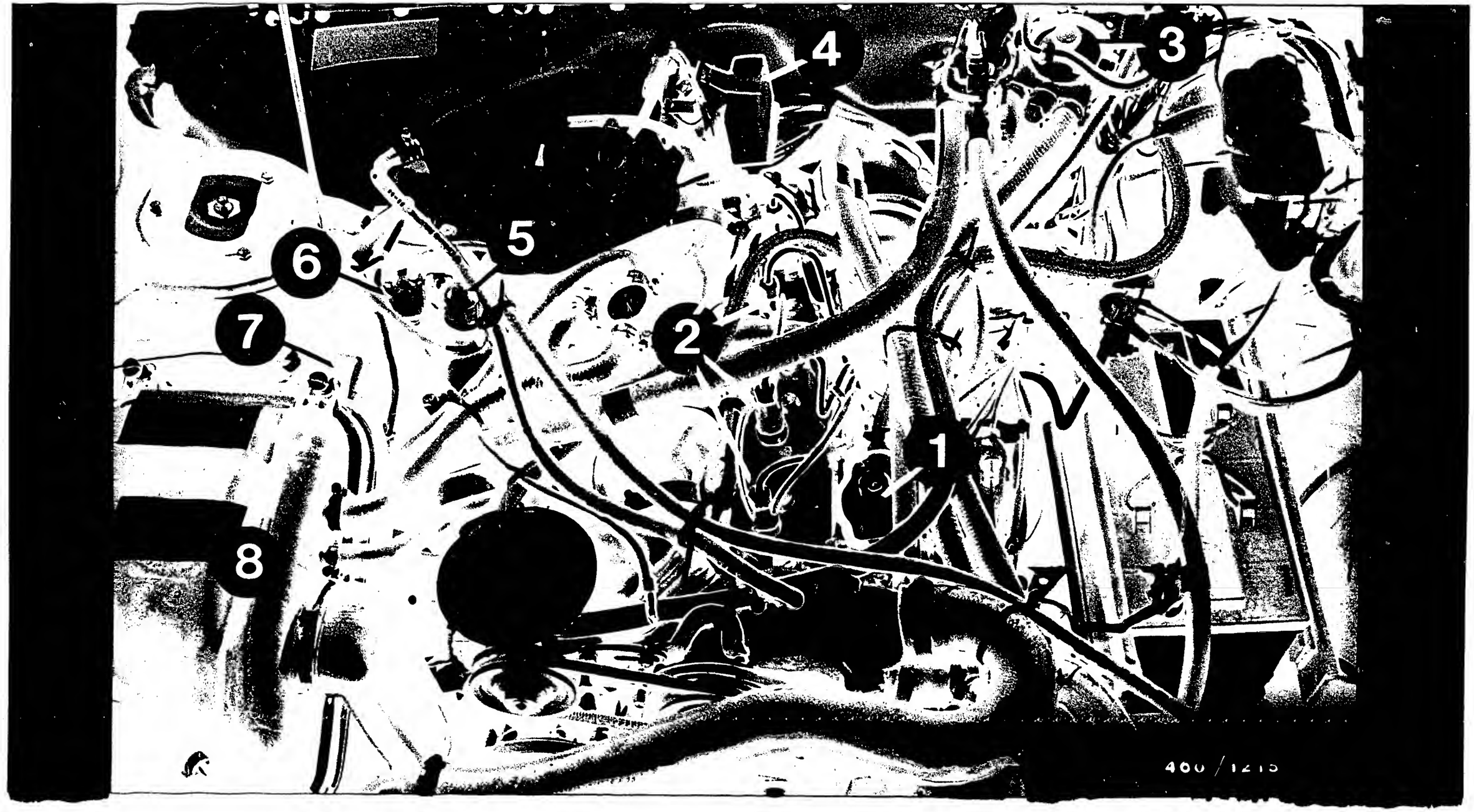
Test equipment and tools (continued)

Description	Part number	Application
Universal test adapter	ETT 018.01 0 684 101 801	Testing EGR with duration-of-injection signal
Test lead	1 684 463 166	Testing EGR with duration-of-injection signal
Multimeter	Commercially available e.g. Miselco Master 50 K	Testing EGR with duration-of-injection signal
VA tester	ETT 011.00 0 684 101 100	Testing the preheating system



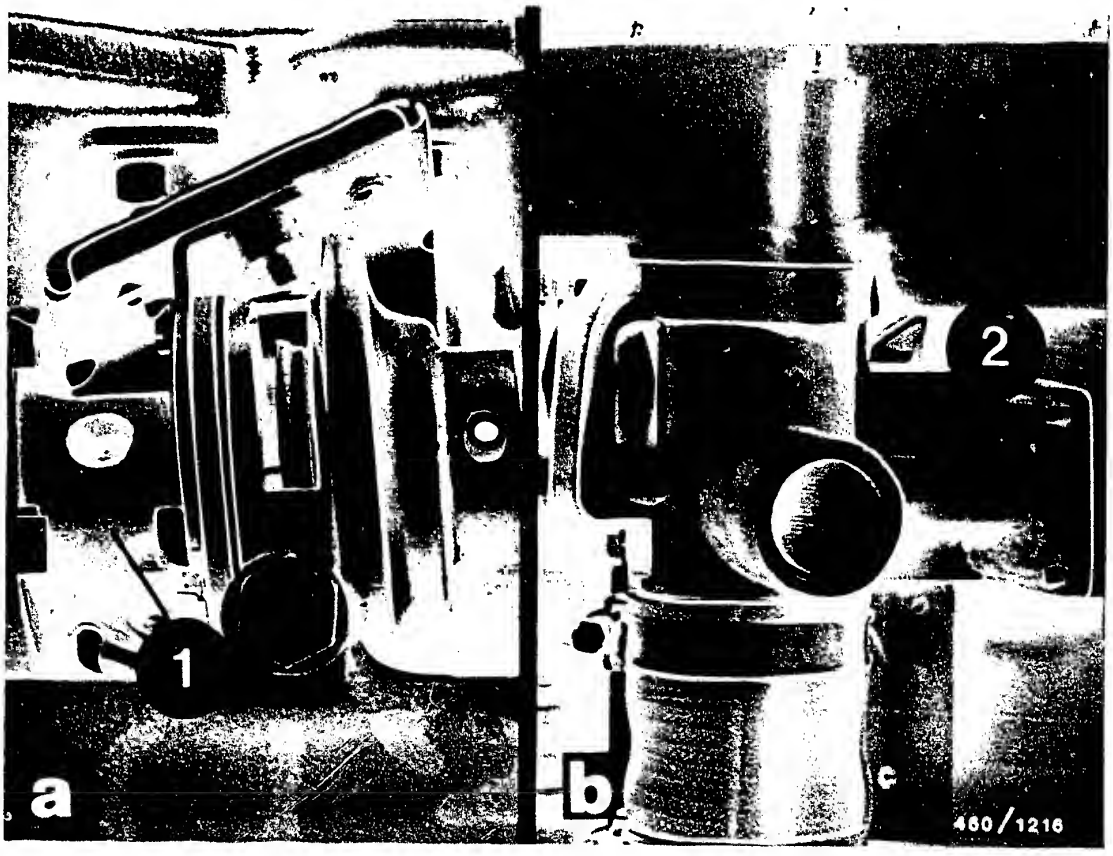
8.1 Construction and use of universal test adapter

1 = Test lead - duration-of-injection - exhaust-gas recirculation 1 684 463 166
1.1 = Connection to wiring harness
1.2 = Connection to control unit
2 = Universal test adapter ETT 018.01 - 0 684 101 801
3 = Test wells for motortester (not used)
4 = Test sockets for voltage measurement
5 = Test sockets for resistance measurement
6 = Test sockets for current measurement
7 = "V" program-selector switch
8 = "Ω" program-selector switch
9 = Button panel for simulation of operating conditions
Button 1 = Simulation of engine "cold" (-20°C)
Button 2 = Simulation of engine "warm" (approx. 80°C)
Button 3 = Not occupied
Button 4 = Not occupied
Button 5 = EGR operation
Button 6 = EGR operation
10 = Multiple plug (vehicle wiring harness)
11 = Control unit



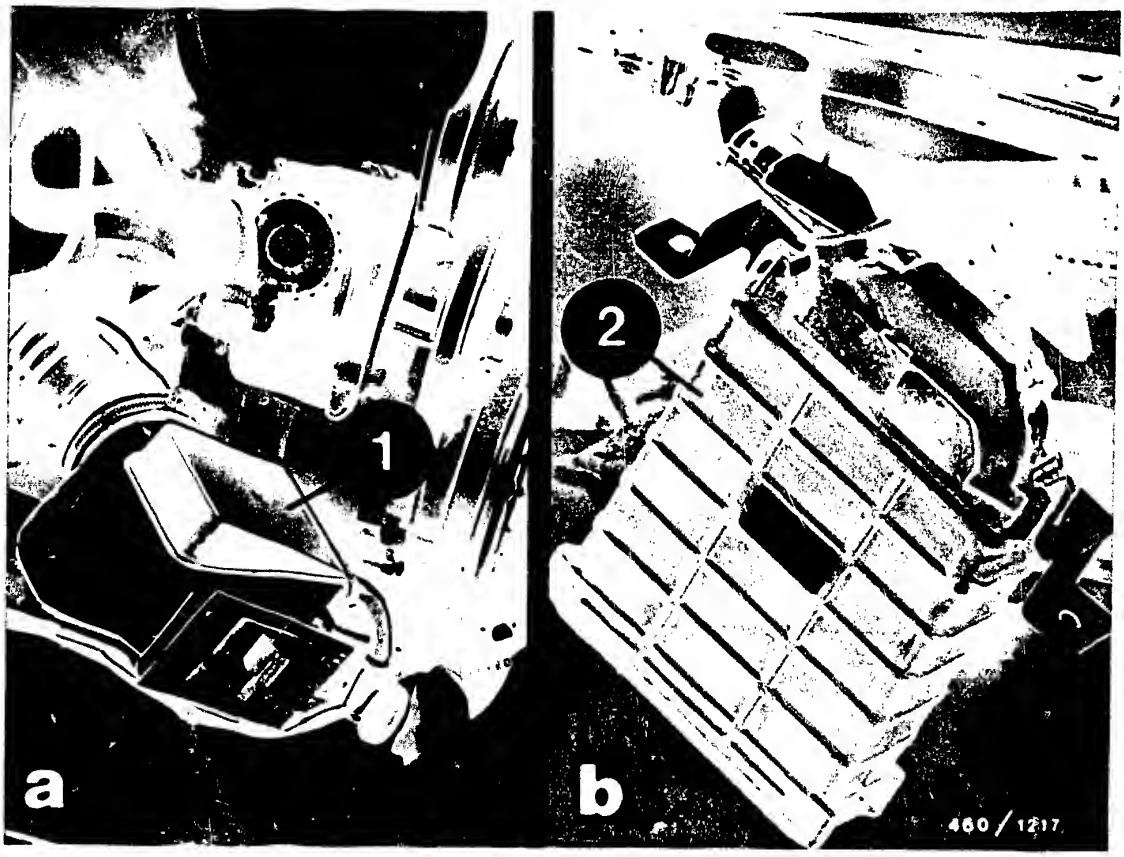
9. Installation position of components - Peugeot 505/604 Turbo Diesel with EGR and duration-of-injection signal (9.83 →)

1 = Fuel-injection pump
2 = Injection nozzles
3 = Fuel filter
4 = Glow-duration unit
5 = Atmosphere solenoid-operated valve
6 = Vacuum solenoid-operated valve
7 = Altitude sensor (engine XD 3T - 2.5 l only)
8 = Air filter

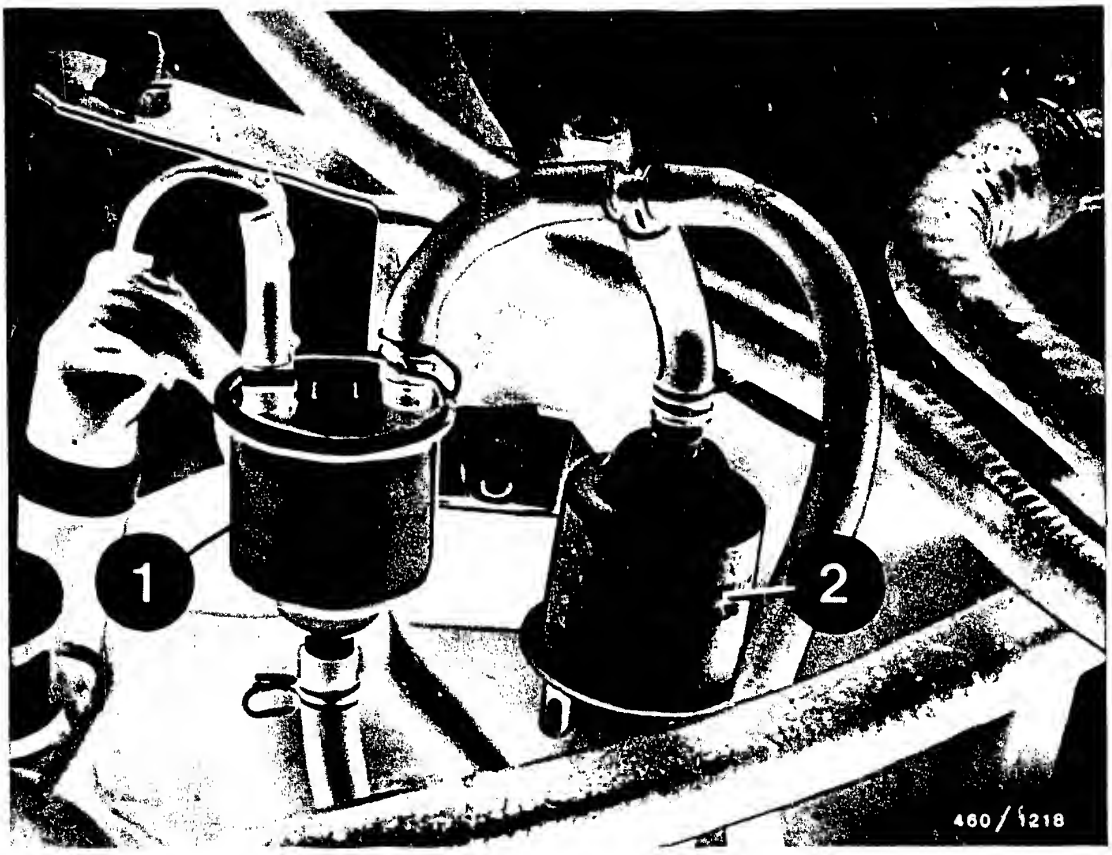


1 = Exhaust-gas recirculation valve

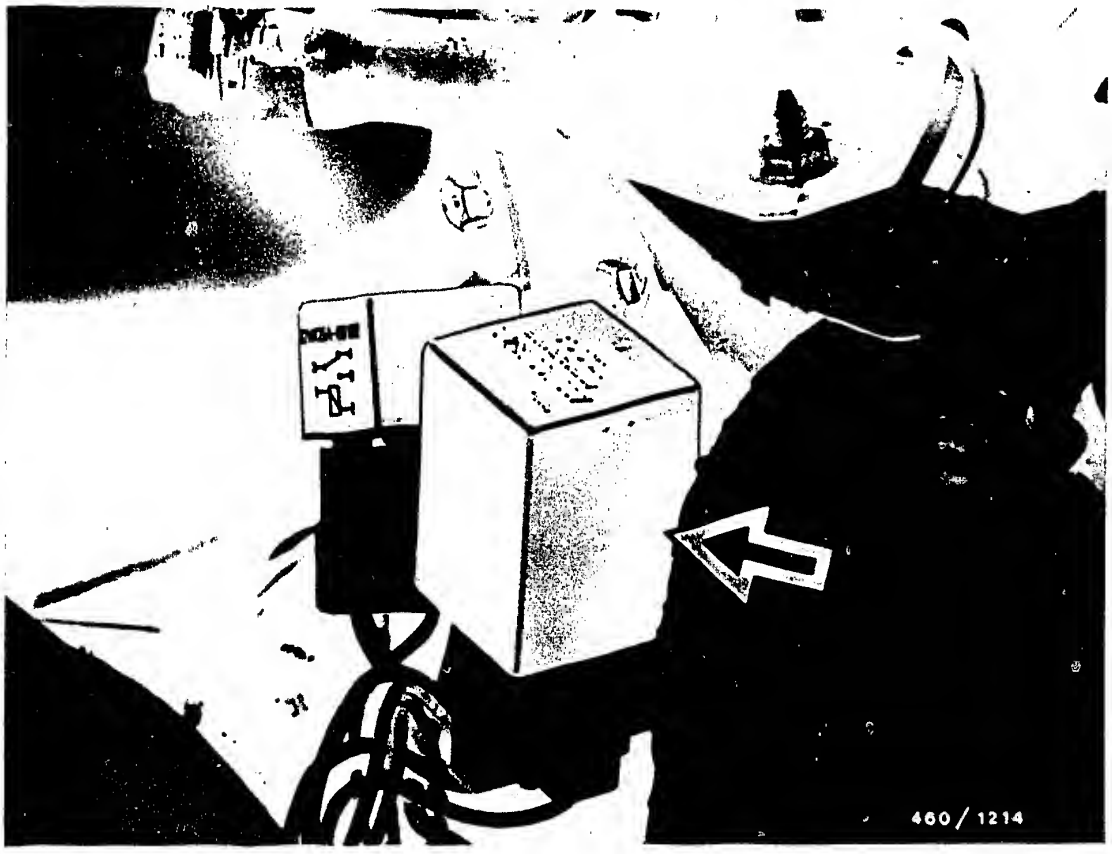
2 = Throttle valve



1 = Air-flow sensor
2 = Control unit (above glove compartment)



1 = Vacuum solenoid-operated valve
2 = Atmosphere solenoid-operated valve



The fuses of the running-time electronics are grouped in a fuse box (see illustration, arrow) which is situated next to the coolant expansion tank.

Notes on installing new nozzles:

- Vehicle with engine XD 2S - 2.3 l:
  Replace fuse box.

- Vehicle with engine XD 3T - 2.5 l:
  Replace fuse box and re-activate counting memory (control unit) by briefly disconnecting the postive pole of the battery.

10. Important general information

- Never start the engine without the battery securely connected.
- Do not use a starting aid with more than 16 V or a fast charger for starting!
- Do not disconnect the battery from the vehicle electrical system with the engine running.
- Disconnect battery from vehicle electrical system before fast-charging.
- Remove the control unit at temperatures above 80°C (paint-drying installation).
- Make sure that all connectors of the wiring harness are correctly seated.
- Do not disconnect or connect the control-unit plug with the ignition on.
- Remove the control unit before carrying out electrical welding work (e.g. spot welding).
- In the case of nozzle holders with an induction-type duration-of-injection sensor (cylinder 2 on this vehicle), exclusively a correction of the opening pressure is allowable for the after-sales service.
- After replacing nozzles, replace fuse box of running-time electronics.

11. Trouble-shooting chart

Customer complaint (fault symptom)

1. Engine fails to start or starts only with difficulty when warm	2. Engine fails to start or starts only with difficulty when cold	3. Engine hunts at idle	4. Rough idle with warm engine	5. Engine missing while driving	6. Unsatisfactory performance	Cause (component fault)	Coordinates
●	●			●	●	Tank empty; tank vent clogged	C 9
	●					Cold-start accelerator not actuated	C 10
	●		●			Injection sequence does not correspond to firing sequence (check routing of injec. lines)	C 11
				●		Overflow restriction clogged	C 12
●	●					Shutoff device defective	C 13
		●		●	●	Inlet-union screws of inlet and return lines clogged (see diagram of fuel lines)	C 16
●	●		●	●	●	Air in fuel system	C 18
	●					Heavy paraffin deposits in filter in winter operation (replace filter box)	C 20
●	●			●	●	Lines leaking or broken; connections loose	C 23
●	●			●	●	Supply lines clogged (test fuel lines)	D 2
●	●			●	●	Injection lines clogged or constricted (test fuel lines)	C 2
			●		●	Test exhaust-gas recirculation system (test using universal test adapter)	E 6

Trouble-shooting chart (continued)

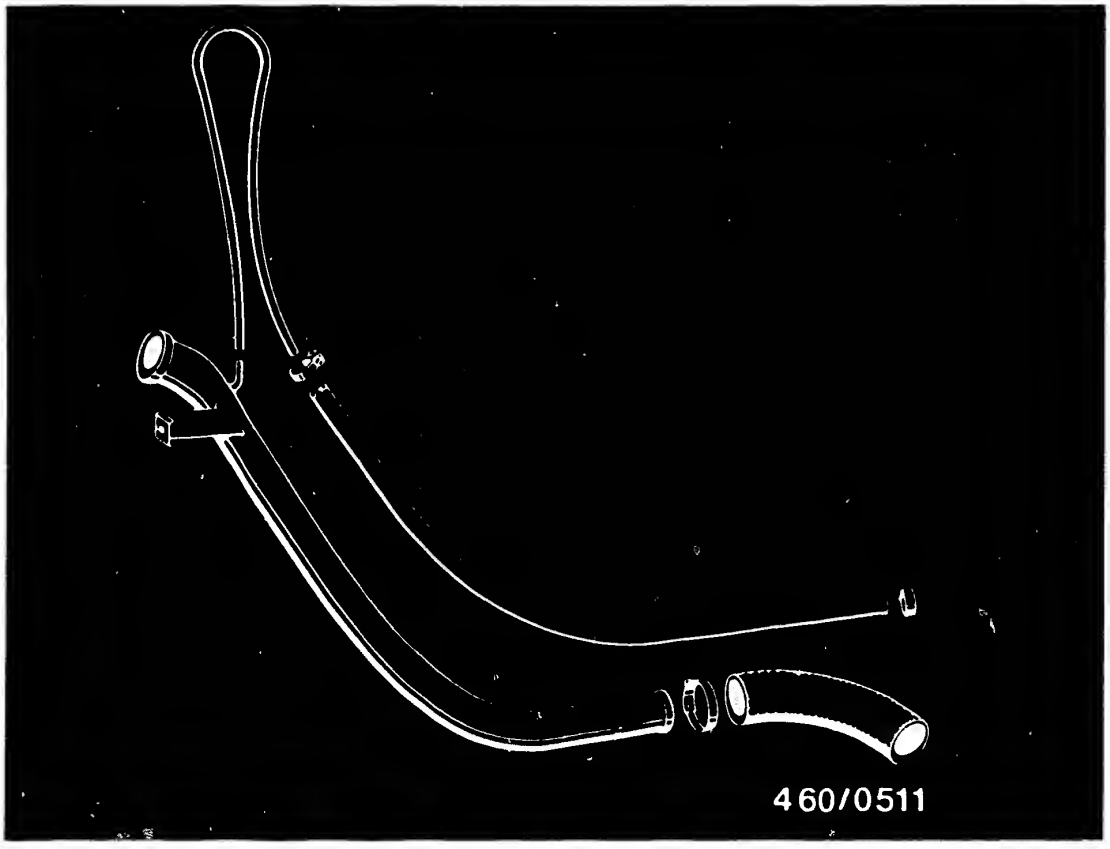
1. Engine fails to start or starts only with difficulty when warm	2. Engine fails to start or starts only with difficulty when cold	3. Engine hunts at idle	4. Rough idle with engine warm	5. Engine missing while driving	6. Unsatisfactory performance	Cause (component fault)	Coordinates
					●	Engine air filter clogged	D 3
			●			Idle speed incorrect	D 10
●	●		●	●	●	Injection nozzle defective	D 16
	●		●		●	Coordination, injection pump - engine (injection timing) incorrect	L 5
●	●			●	●	Fuel filter clogged (differential-pressure test)	E 3
	●					Preheating system defective	G 21
					●	Timing device defective	H 14
	●		●			Engine compression poor or uneven	H 15
					●	Maximum speed incorrectly set (remove injection pump)	J 1
●	●	●	●	●	●	Injection pump (governor) defective or out of adjustment	J 1
					●	Check turbocharger for leaks and charge-air pressure	L 19

Trouble-shooting chart (continued)

7. Unsatisfactory engine performance in conjunction with high fuel consumption and smoking	8. Engine cannot be switched off	9. Engine runs rough in conjunction with black smoke in full-load range; possibly lack of power	10. Fog-like smoke in full-load range (white)	11. Incorrect engine speeds	12. Engine will not accelerate when cold	13. Distributor-type fuel-injection pump overheating	14. Black smoke in full-load range; possibly lack of power	Cause (component fault)	Coordinates
			●		●			Supply lines clogged (test fuel lines)	D 2
			●		●			Injection lines clogged or constricted (test fuel lines)	D 2
●							●	Engine air filter clogged	D 3
				●				Idle speed incorrect	D 10
●		●						Injection nozzle defective	D 16
●		●	●		●			Coordination, injection pump - engine (injection timing) incorrect	L 5
			●		●			Fuel filter clogged (differential-pressure test)	E 3
		●	●					Timing device defective (remove injection pump)	H 14
●					●			Engine compression poor or uneven	H 15
				●				Maximum speed incorrectly set (remove injection pump)	J 1
●	●	●	●	●	●	●		Injection pump (governor) defective or out of adjustment (remove injec. pump)	J 1
●								Check engine timing	K 8

Trouble-shooting chart (continued)

7. Unsatisfactory engine performance in conjunction with high fuel consumption and smoking	8. Engine cannot be switched off	9. Engine runs rough in conjunction with black smoke in full-load range; possibly lack of power	10. Fog-like smoke in full-load range (white)	11. Incorrect engine speeds	12. Engine will not accelerate when cold	13. Distributor-type fuel-injection pump overheating	14. Black smoke in full-load range; possibly lack of power	Cause (component fault)	Coordinates
			●		●			Tank empty; tank vent clogged	C 9
					●			Cold-start accelerator not actuated	C 10
		●		●	●			Injection sequence does not corres. to firing seq. (check routing injec. lines	C 11
						●		Overflow restriction clogged	C 12
	●							Shutoff device defective	C 13
			●	●	●			Inlet-union screws of inlet and return lines clogged (see diag. of fuel lines)	C 16
			●		●			Air in fuel system	C 18
					●			Heavy paraffin deposits in filter in winter operation (replace filter box)	C 20
●								Lines leaking or broken; connections loose	C 23
							●	Exhaust-gas recirculation system (test using universal test adapter)	E 6



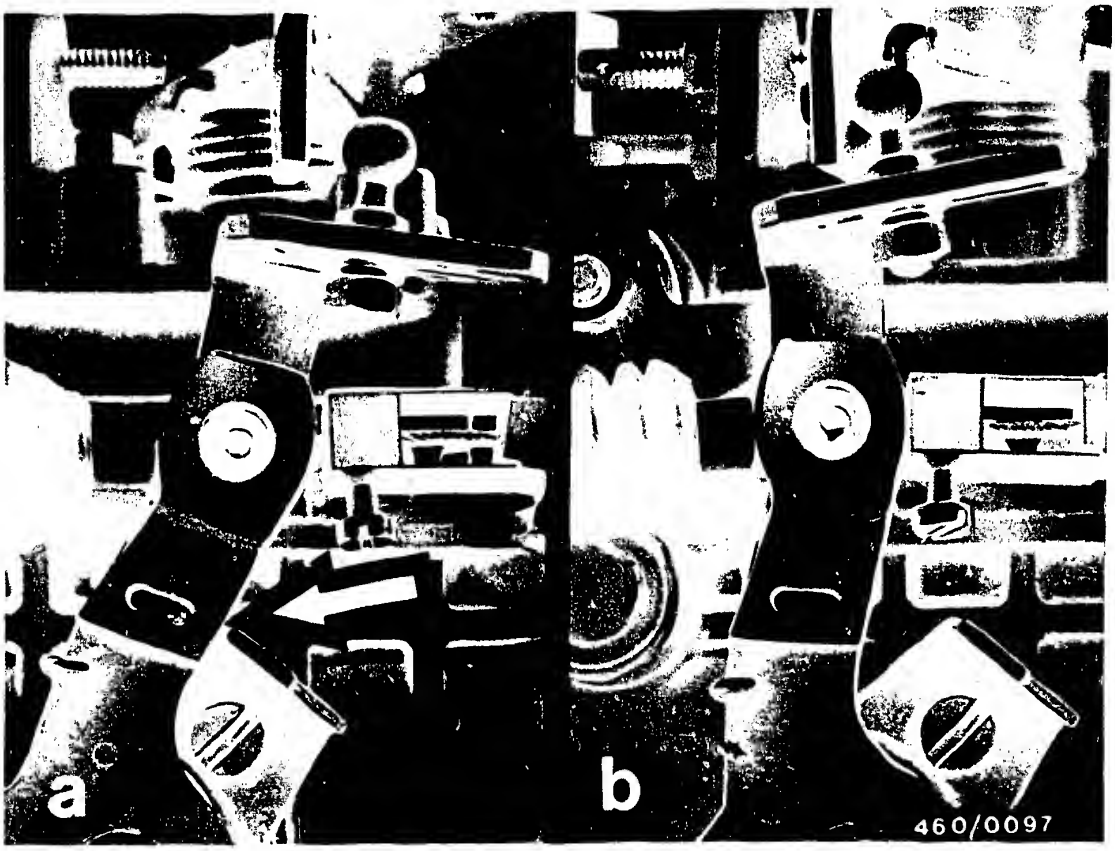
12. Check tank vent

Open the tank cap.

If the defect no longer occurs when the tank cap is open, the tank vent is defective.

Remove the hoses for the tank vent (Figure)and check for clogging or restrictions.

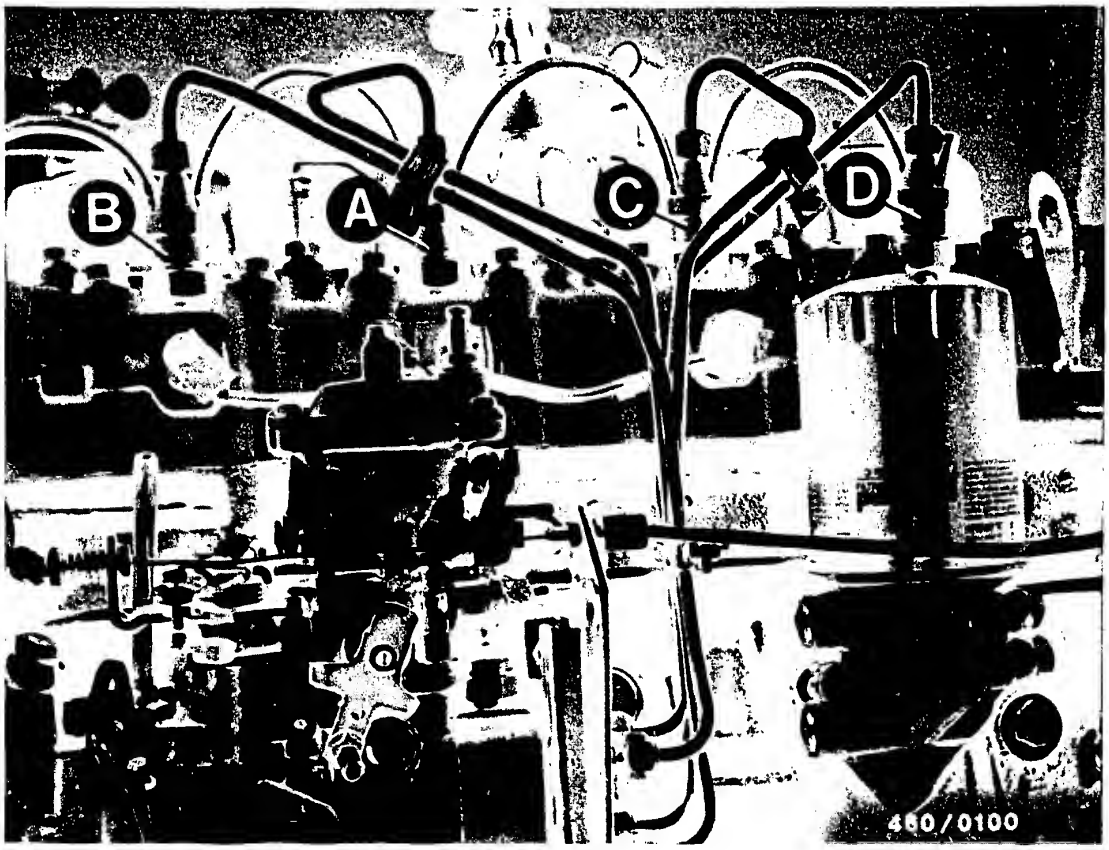
If need be, check the connecting pipe at the task.



13. Checking operation of the cold-start accelerator XD3T 2.5 l engine

If the cold-start accelerator is set correctly, the control lever for the cold-start accelerator must lie against the stop bracket (Figure a, arrow) when the engine is at normal operating temperature (cooling water temperature approx. + 80°C).

When the engine is cold, the control lever for the cold-start accelerator has reached its maximum working stroke (Figure b).
If the control lever when cold stays at the stop bracket or only moves slightly, the fuel-injection pump must be taken out and readjusted.

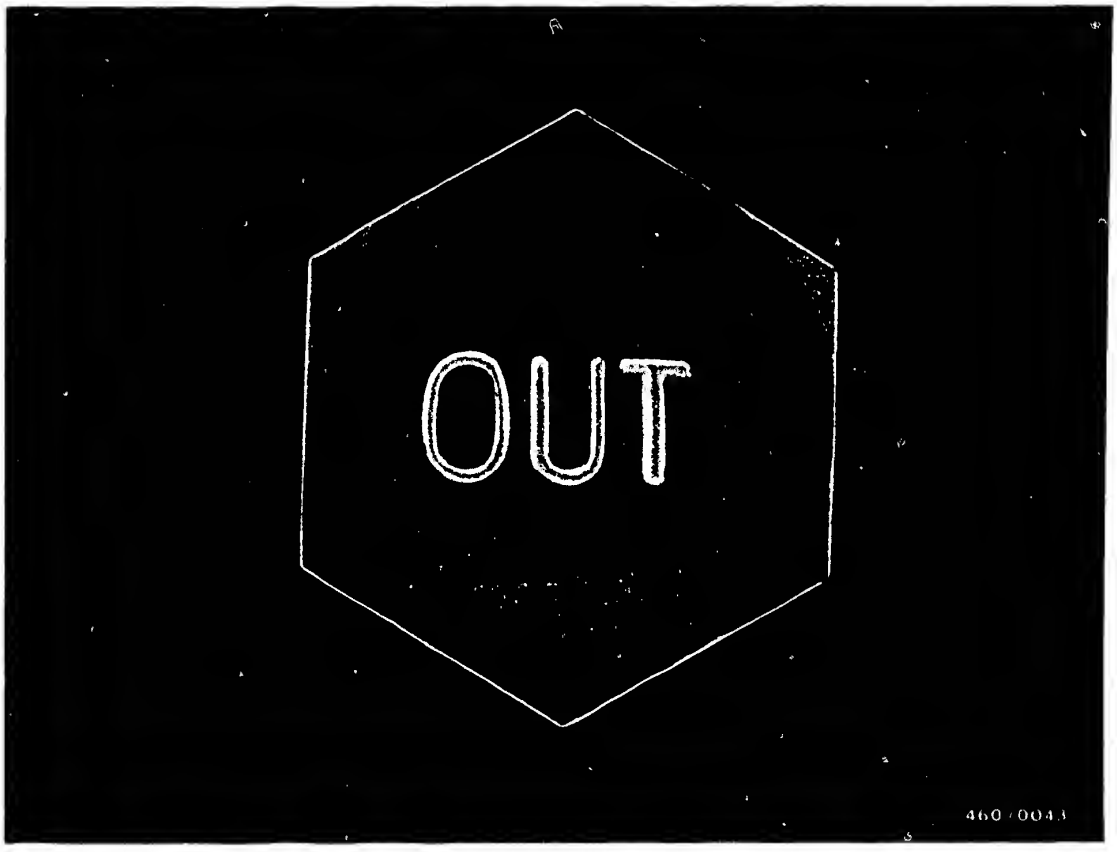


14. Checking how fuel-delivery lines are laid

The fuel-delivery lines are connected to one another by means of clips to prevent mistaking the outlets one for the other.

If confusion still occurs, check how the lines are laid against the figure at the top.

Assignment of the fuel-injection pump outlets to the individual engine cylinders is identified by means of the letters A to D.

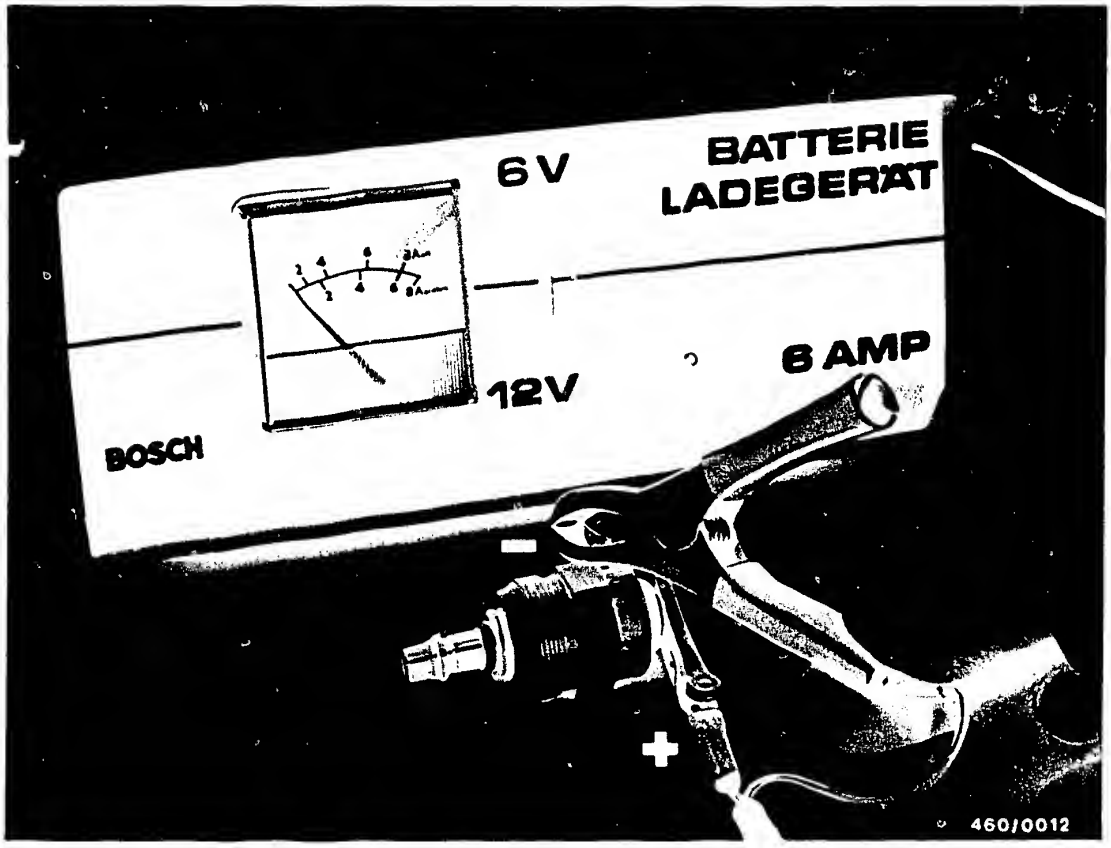


15. Checking the overflow restriction

Unscrew the overflow restriction on the fuel-injection pump (identified with "out").

Inspect the wire filter installed visually for dirt.

If there is doubt, take out and replace the overflow restriction.



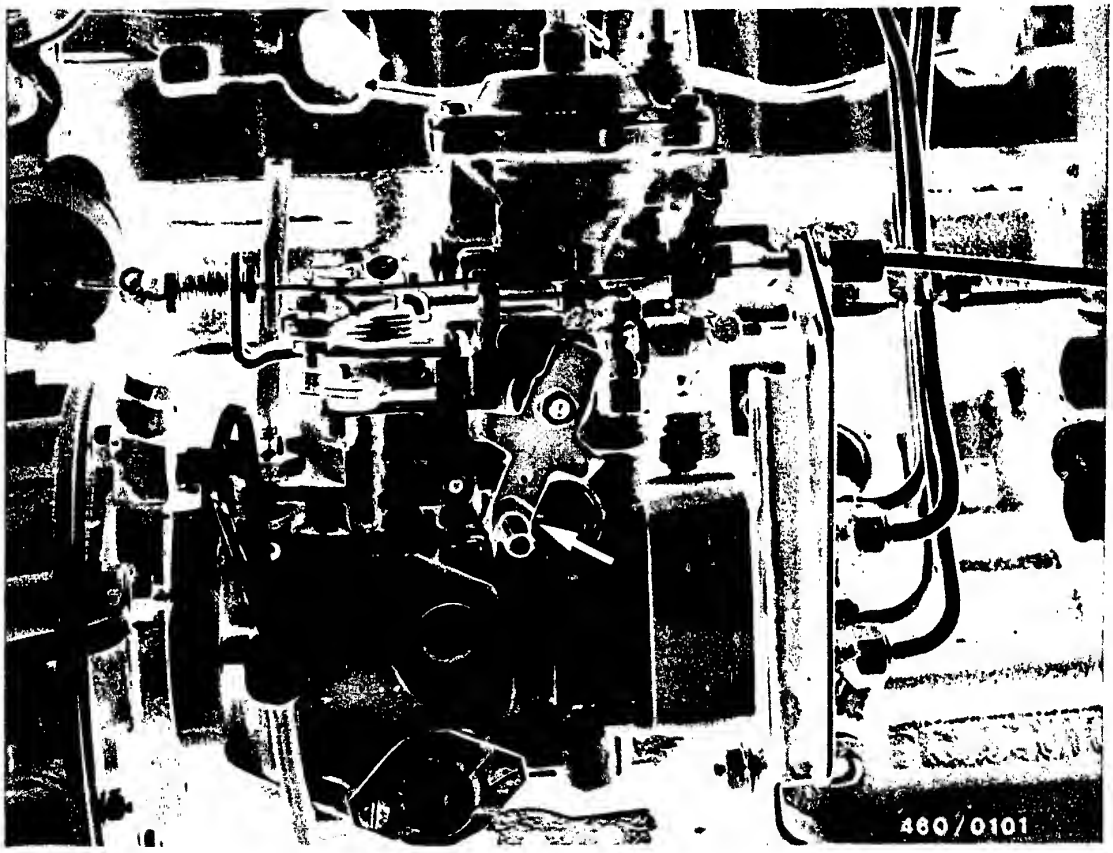
16. Checking operation of the shutoff device

16.1 Engine does not start

Check that the solenoid-operated valve is being supplied with voltage (min. 10 V) when the glow-plug and starting switch is switched on (driving position).
If there is voltage present, take out the fuel-injection lines and remove the solenoid-operated valve.
Be careful to be neat and clean in so doing!

Check the operation of the solenoid-operated valve after it has been taken out.

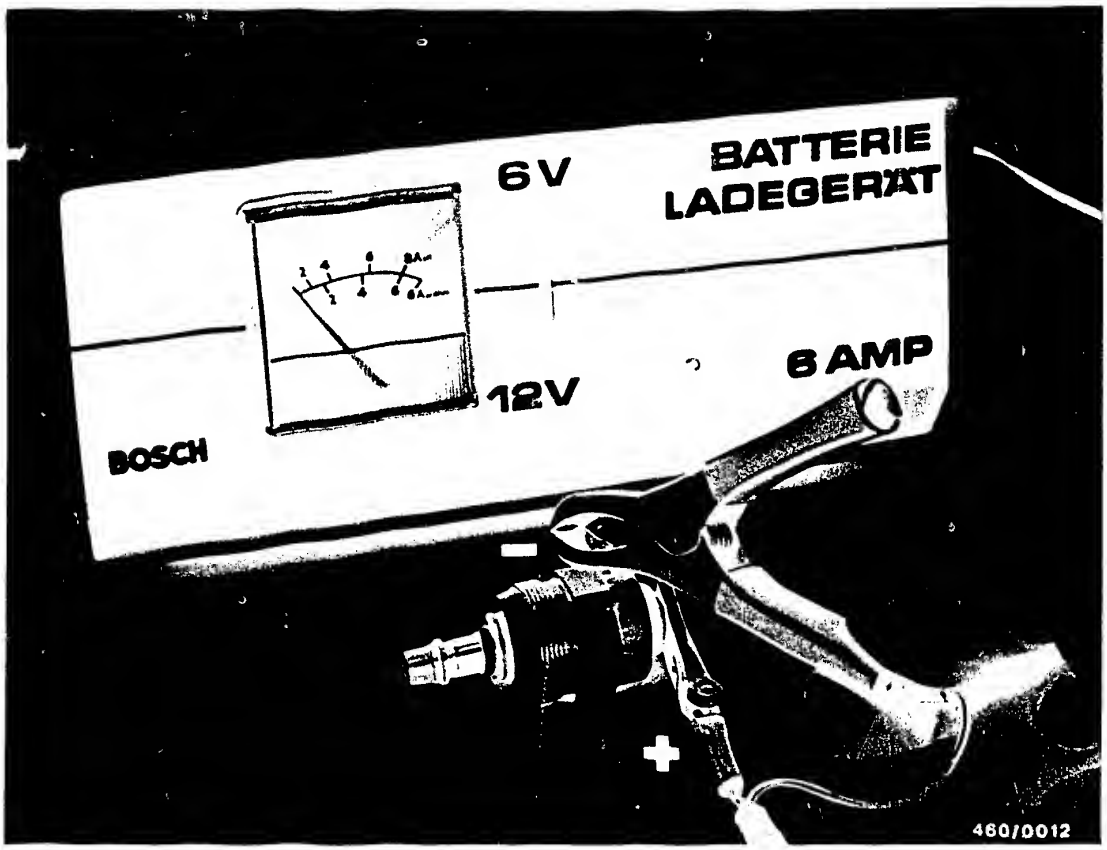
Note:
When the solenoid-operated valve has been taken out, it may be supplied with voltage only for a short time, because there is no fuel cooling.



16.2 The engine cannot be shut off

When the glow-plug starting switch is in the stop position, it is not permissible for there to be any voltage at the solenoid-operated valve, i. e., the supply of fuel to the distributor plunger is interrupted.

If the engine continues to run even though there is no voltage at the solenoid-operated valve, operate the emergency shutoff lever (arrow) on the fuel-injection pump.



16.2.1 Checking the solenoid-operated valve

Remove the fuel-injection lines.

Take out the solenoid-operated valve.

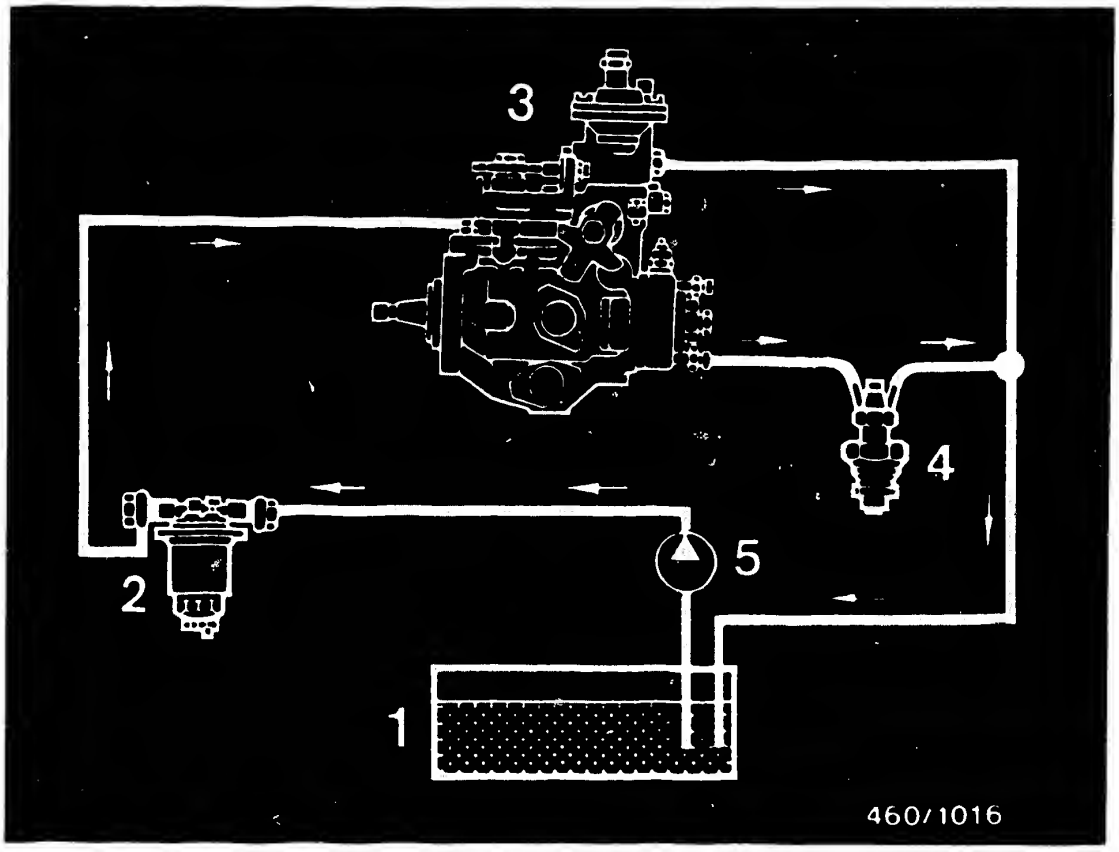
Be careful to be clean and neat in so doing!

Check the operation of the solenoid-operated valve when it has been taken out of the vehicle.

Note:

After the solenoid-operated valve has been taken out, it may be supplied with voltage only for a short time, because there is no fuel cooling.

Check the valve seat in the hydraulic head (visual inspection).

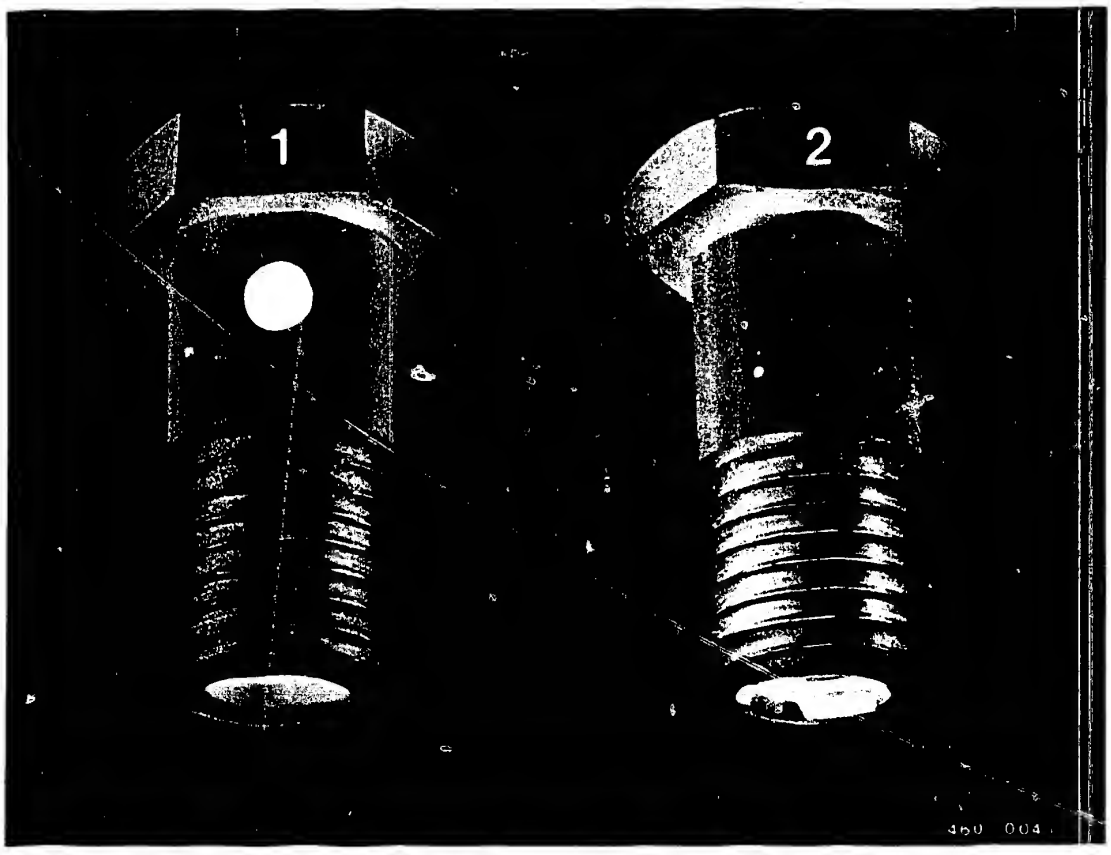


1 = Fuel tank
2 = Fuel filter
3 = Distributor-type fuel-injection pump
4 = Fuel-injection nozzles

17. Connection diagram for the fuel lines

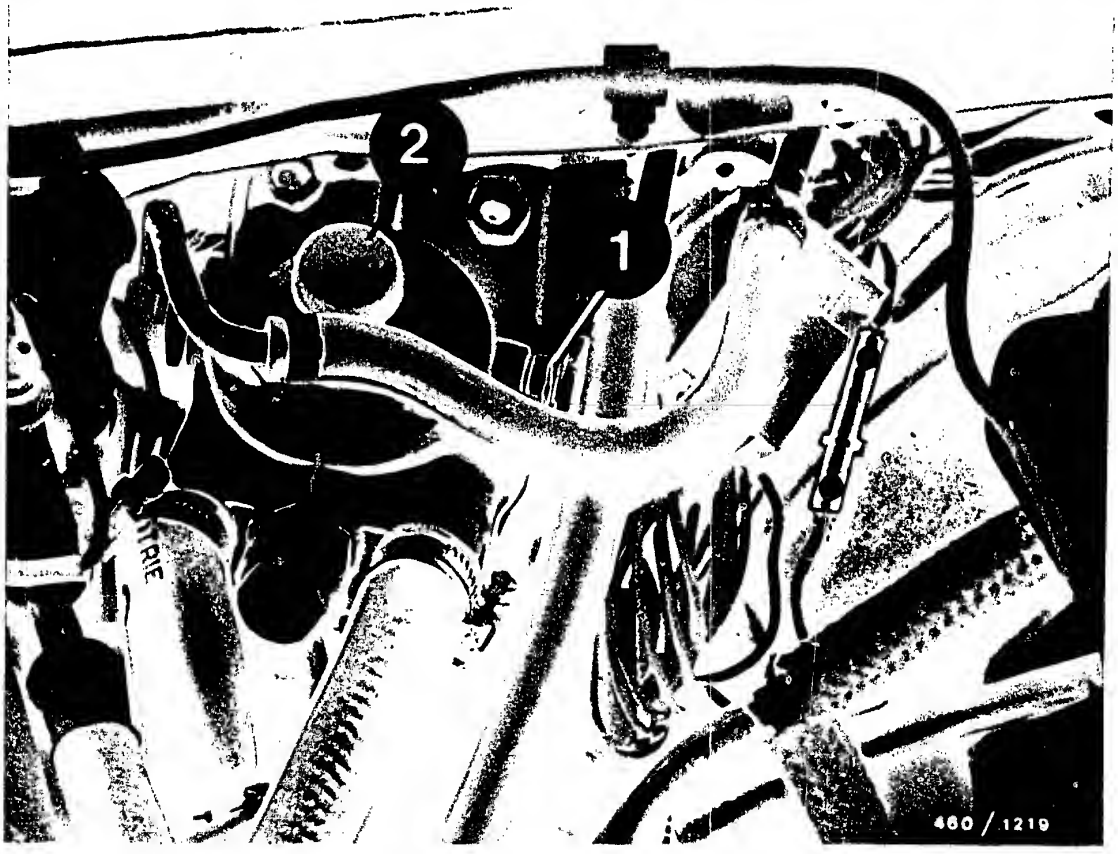
The fuel lines have been connected as shown in the diagram above.

The fuel flows in the direction shown by the arrows.



At the connections for the fuel-injection pump, make certain that the inlet-union screw for the fuel inlet (1) and the throttle screw for the fuel return (2) are not confused one for the other.

The throttle screw is located on the cover of the fuel-injection pump and identified by the word "out" on the screw head.

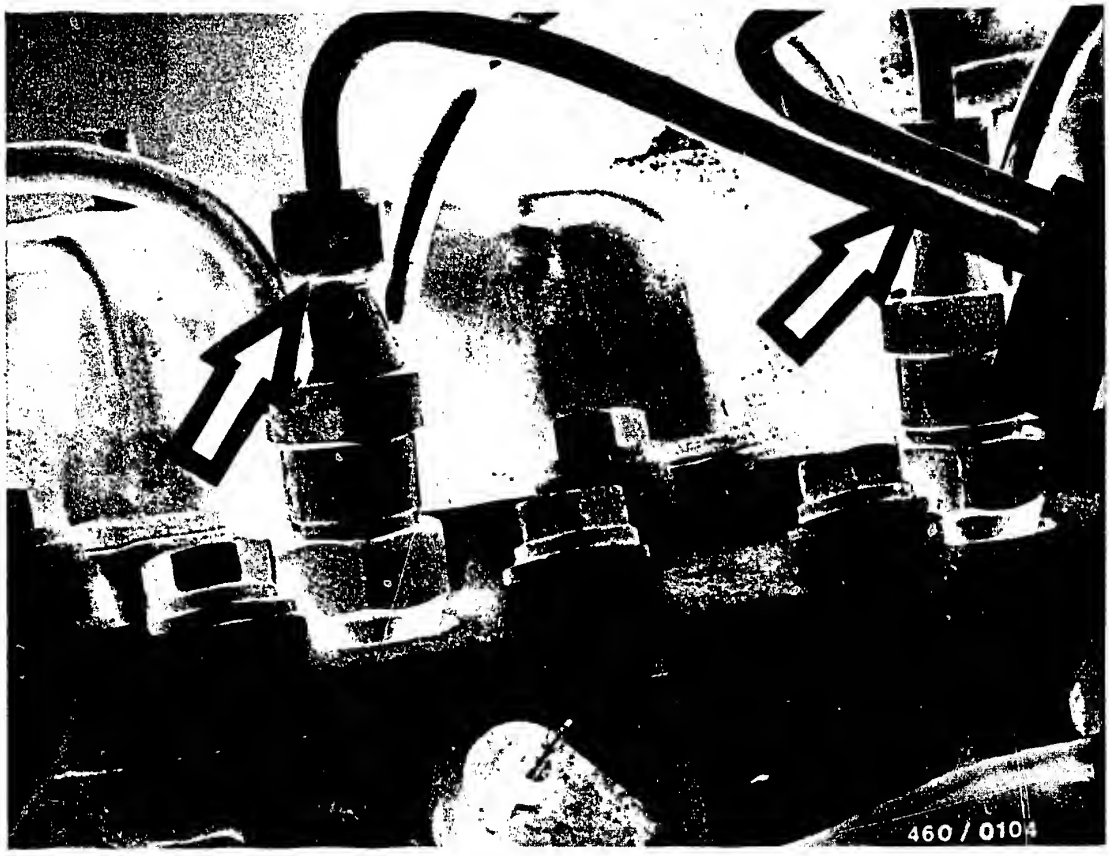


18. Bleed the fuel system

Release the bleeder screw (1) and operate the handpump (2) until the fuel coming out at the bleeder screw (1) is free of bubbles.

Retighten the bleeder screw (1).

Continue working the handpump (2) again until resistance can be felt.

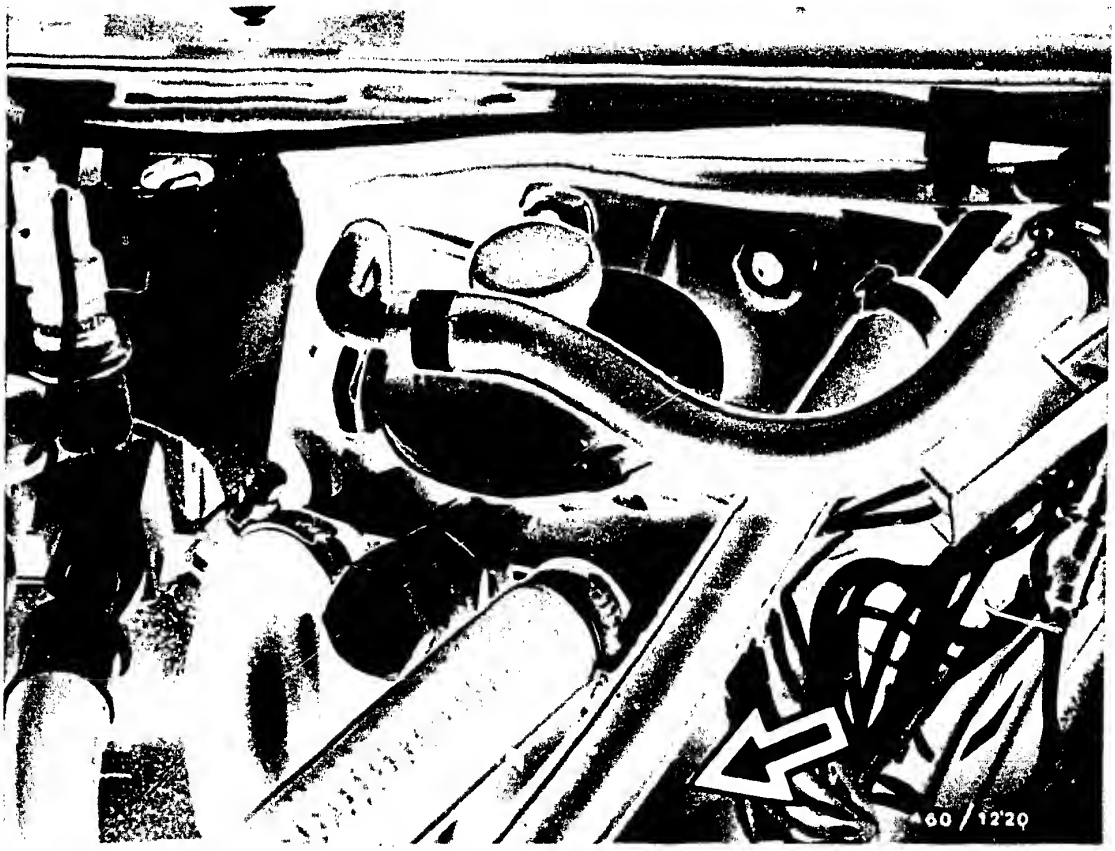


Release the union nuts of the fuel-delivery lines at the fuel-injection nozzle holder assemblies (see illustration, arrows).

Operate the engine starting motor without preheating until fuel comes out at the union nuts of the fuel-injection nozzle holder assemblies.

Tighten the union nuts.

Run the starting motor until the engine starts.



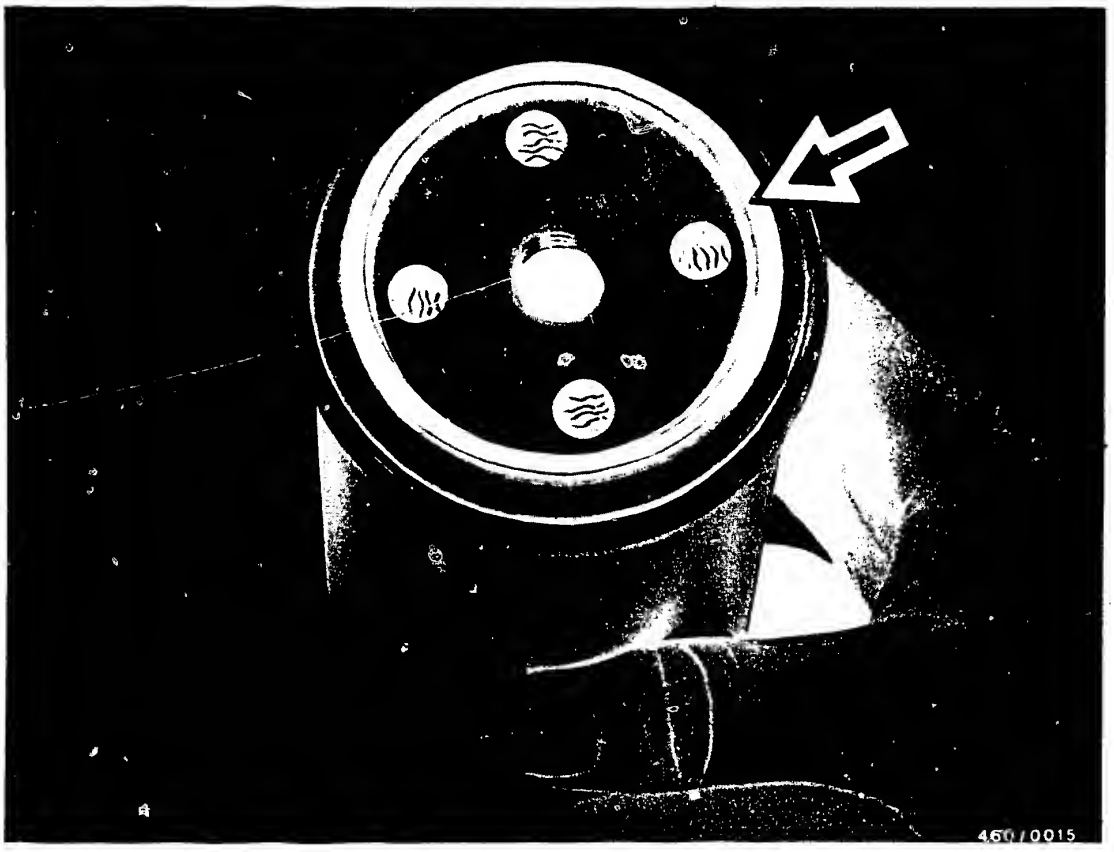
19. Replace and drain water from filter box

19.1 Replace filter box

Screw fuel filter (see illustration, arrow) out of filter cover.

If stuck, loosen filter box with special wrench, e.g. Matra W 167.

Catch any escaping fuel.



Rub diesel fuel into the rubber seal (arrow) of the new filter box.

Screw the filter box into the cover by hand and tighten it.

Check the fuel filter for leaks.

Under some circumstances, add kerosene to winter fuel in accordance with the specifications of the vehicle manufacturer.

19.2 Draining the fuel filter

Unscrew the bleeder screw (arrow) on the filter cover by a few turns.

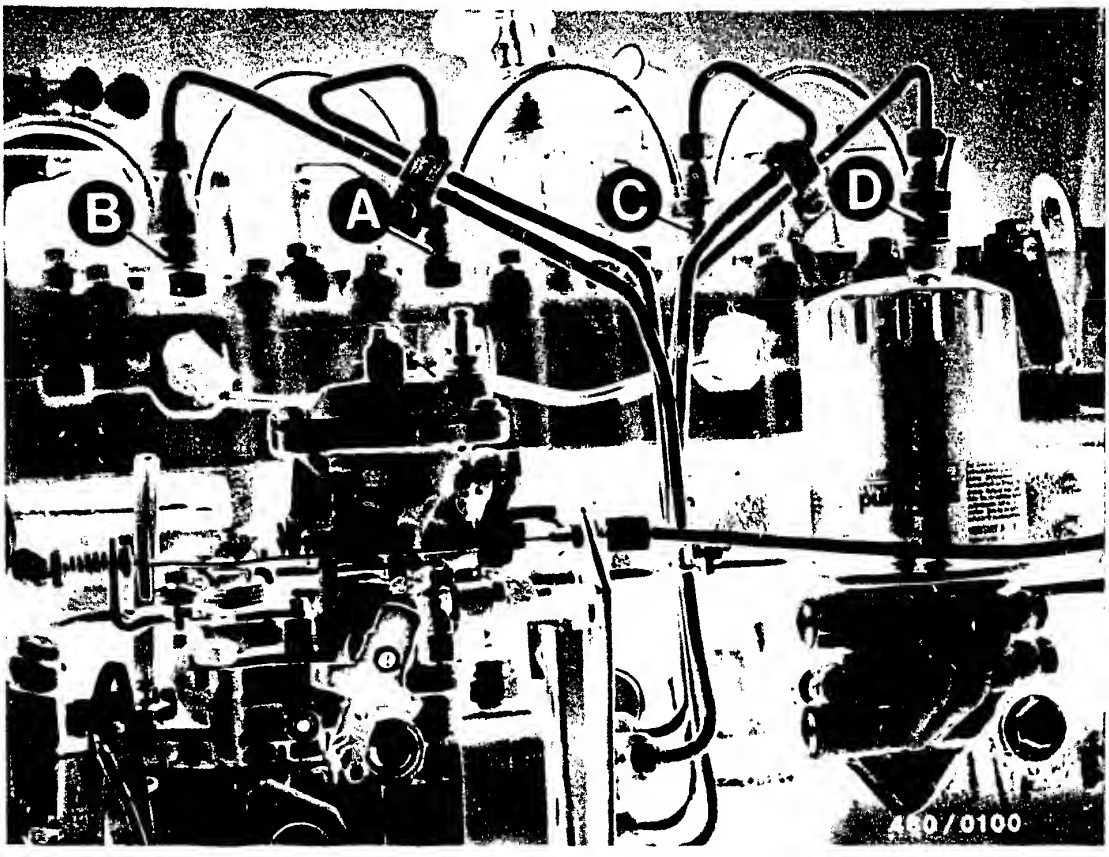
Release the water drain screw at the base of the filter and drain out the water.

Catch the liquid in a catch basin.

Tighten the water drain screw and the bleeder screw and check for leaks.

If need be, bleed the fuel filter.

Note:
The vehicle is equipped with a water-level indicator: when a certain water level is reached, an indicator lamp in the instrument panel lights up.



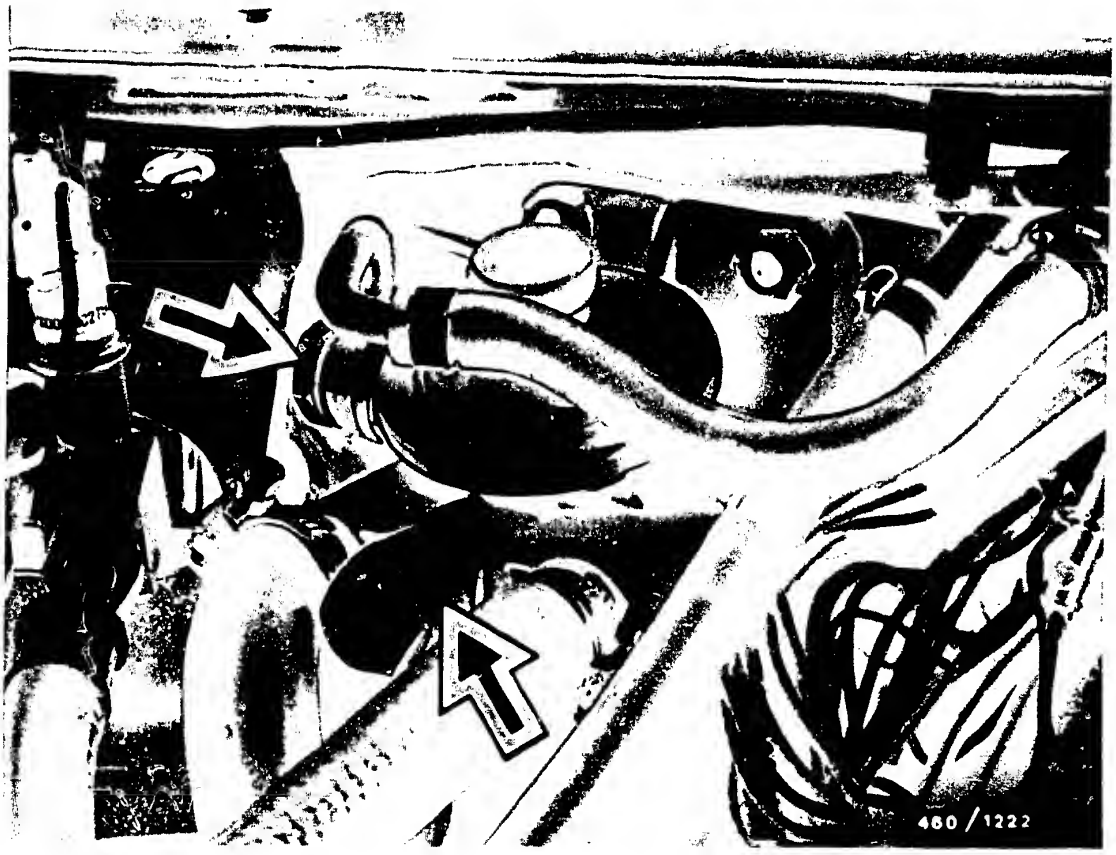
20. Check injection system for leaks

Check injection system for leaks with engine at normal operating temperature.

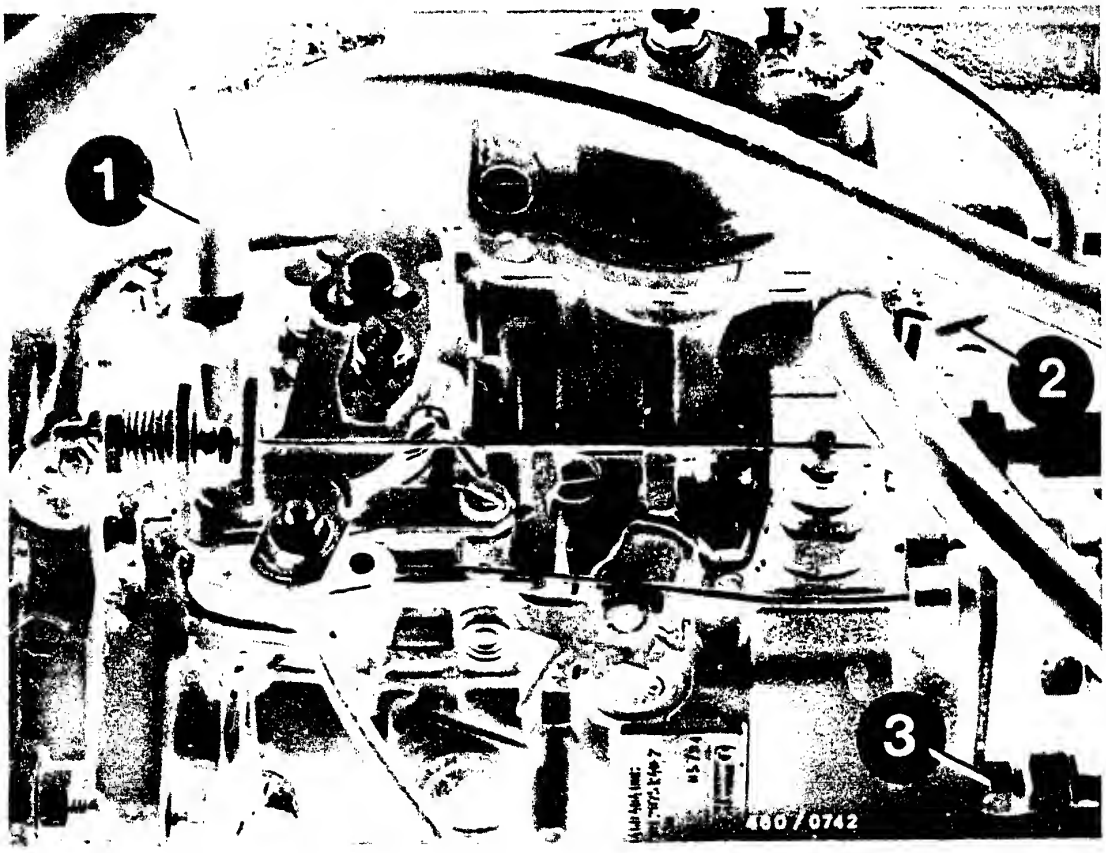
Check all connections of fuel lines.

Pay particular attention to:

- Connections at injection-nozzle holders (A...D).



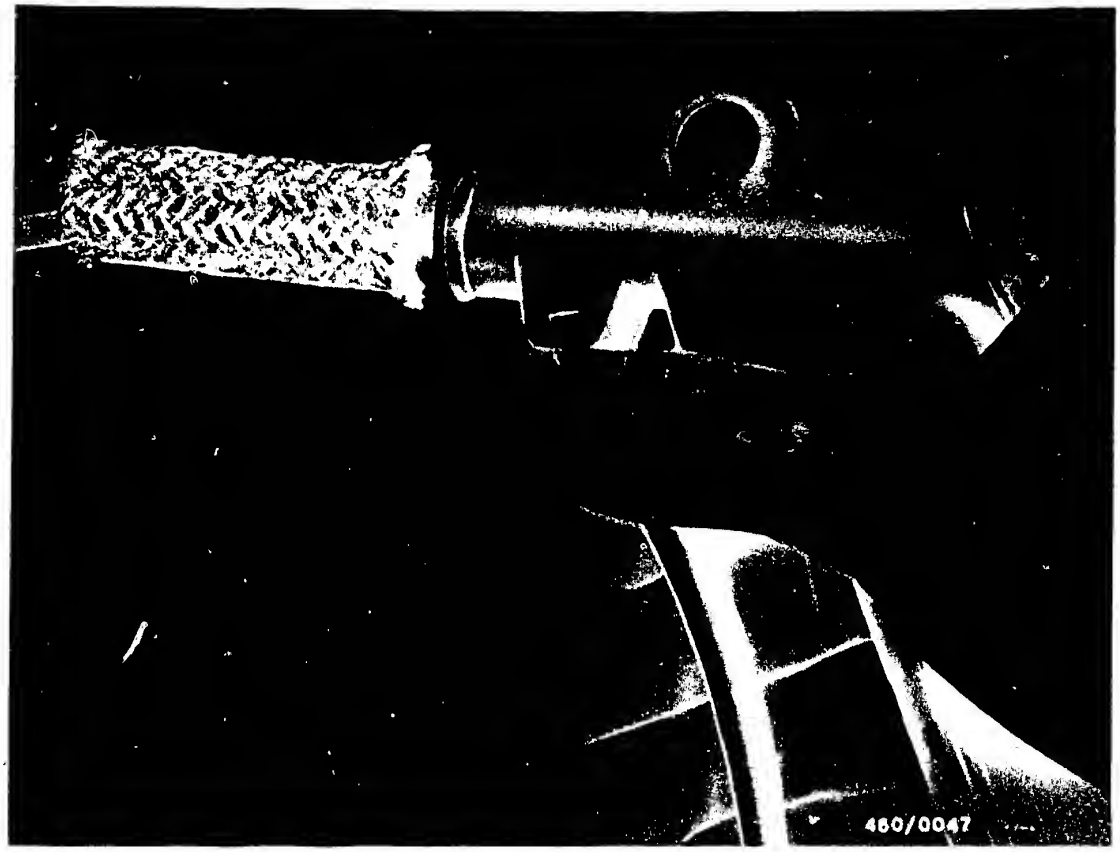
- Connections on fuel filter (see illustration, arrows).



1 = Inlet line
2 = Return line
3 = Delivery-valve holder

- Inlet line and return line on distributor-type fuel-injection pump.
- Delivery-valve holder on hydraulic head.

Examine fuel lines for hairline cracks.



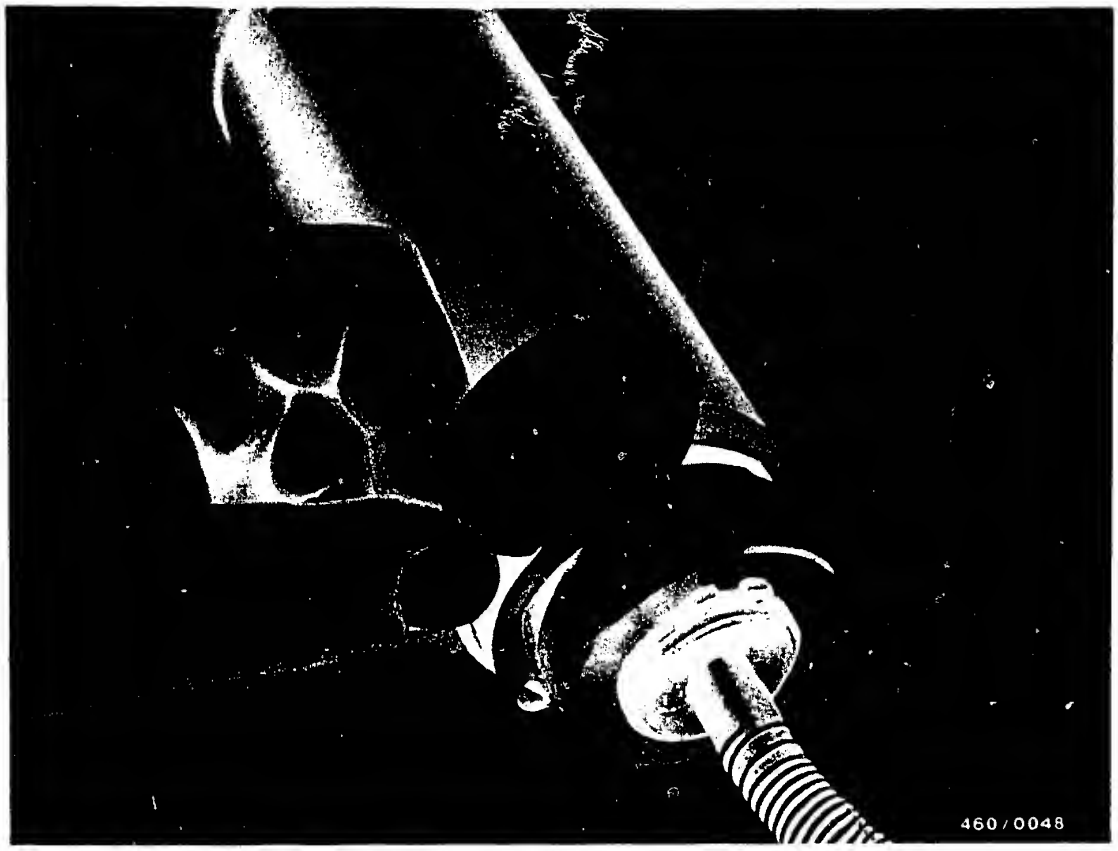
21. Checking fuel lines

Make visual inspection of fuel lines where a problem is suspected.

If no pinching or kinking can be seen, take the fuel line in question out.

Using compressed air, check the fuel line for open passage. If need be, clean it.

A suitable piece of hose can be used as a seal at the sides when blowing through the fuel lines.



22. Exhaust test - Checking the air filter

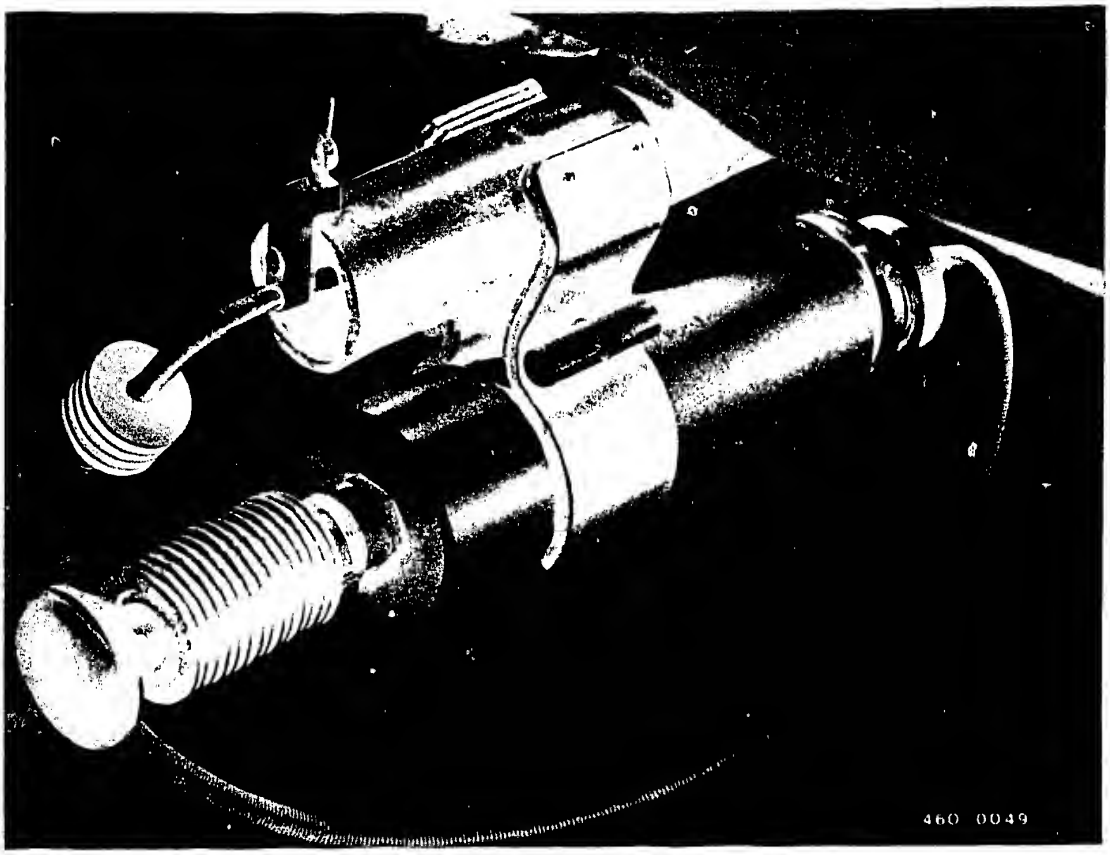
22.1 Test set-up

The exhaust test is run using the Bosch exhaust tester.

The exhaust tester consists of the following instruments:

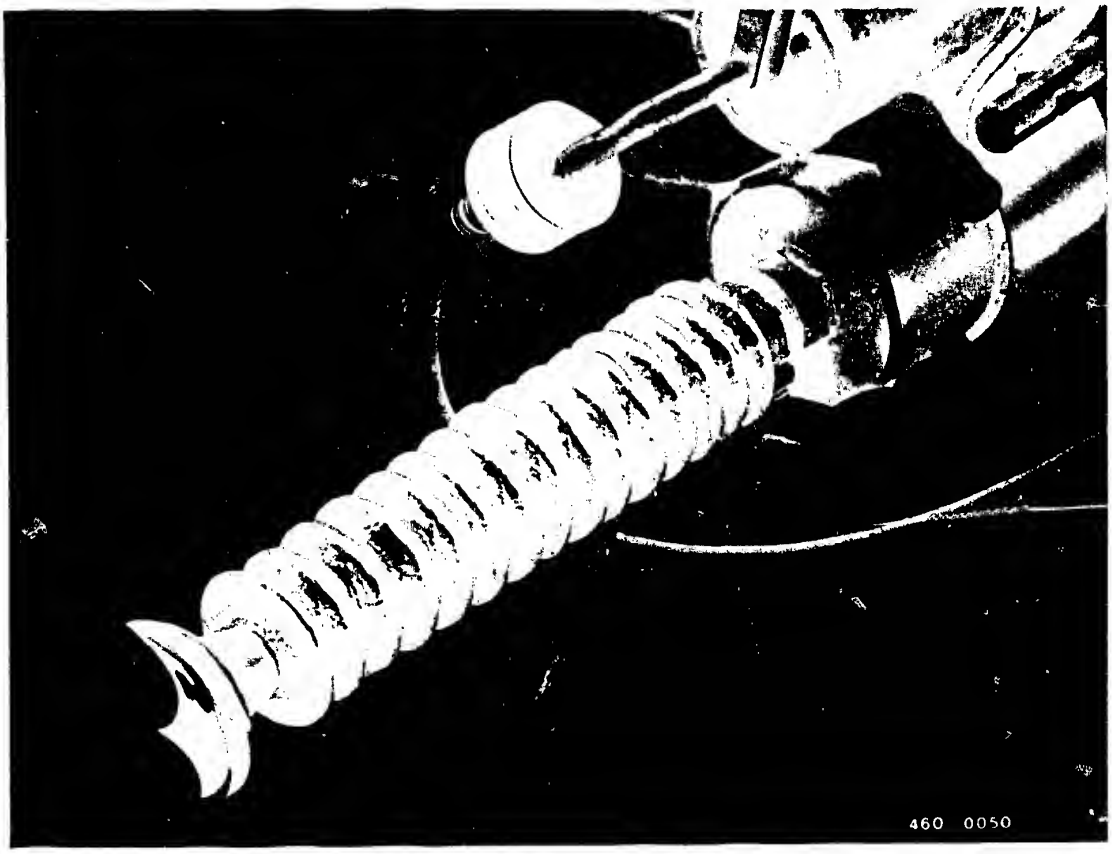
- Accessory box with metering pump 0 681 169 038
- Evaluation unit 0 684 102 050

Insert the filter disc into the metering pump.



Fasten the metering device to the exhaust pipe using an appropriate bracket.

Insert sampling probe as deep as possible into the exhaust pipe and clamp it fast.



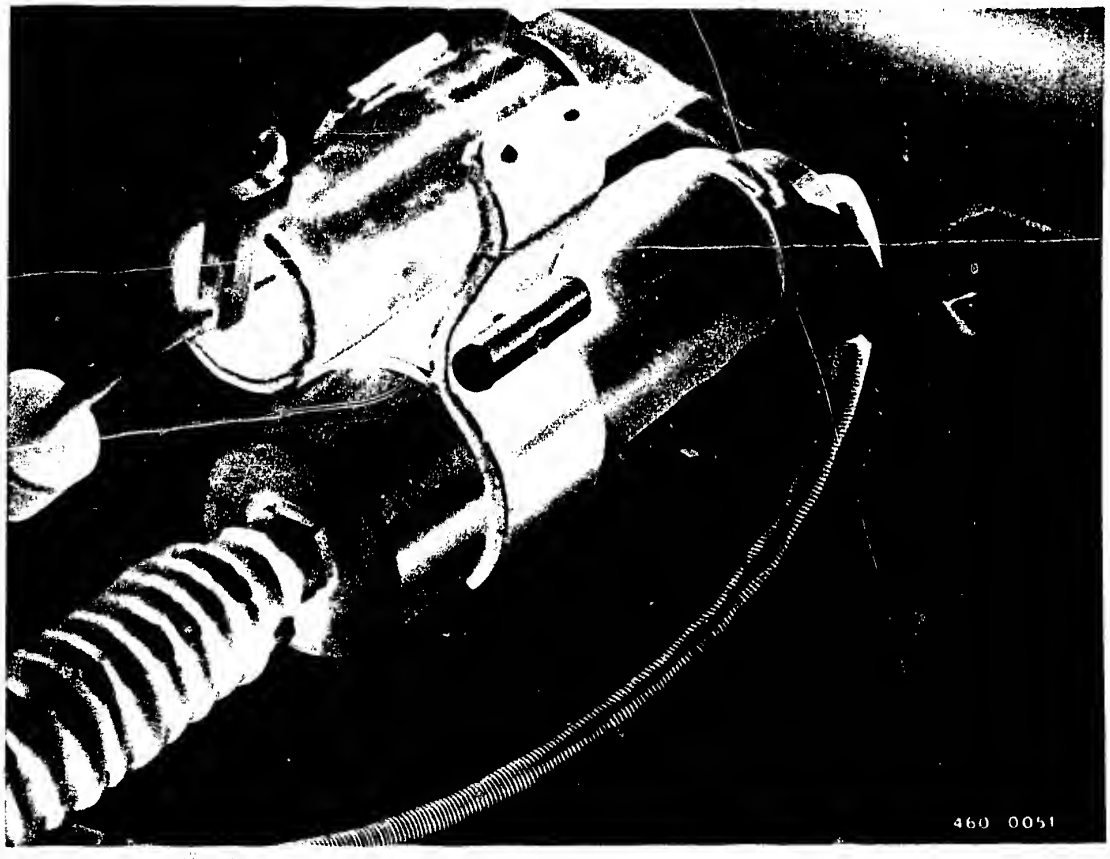
22.2 Test procedure

Cock the metering pump by shoving the black pressure knob in.
Take the rubber ball on the triggering hose along into the passenger compartment.

The test can be run on the "roller" (chassis dynamometer) or on the road (incline).

In every case, prefer testing on the chassis dynamometer.
Select the gear in which a velocity of approx. 40 km/h is attained with the accelerator pedal in the full-load position.

Load the engine enough so that a velocity of approx. 25 km/h is attained with the same accelerator pedal setting.



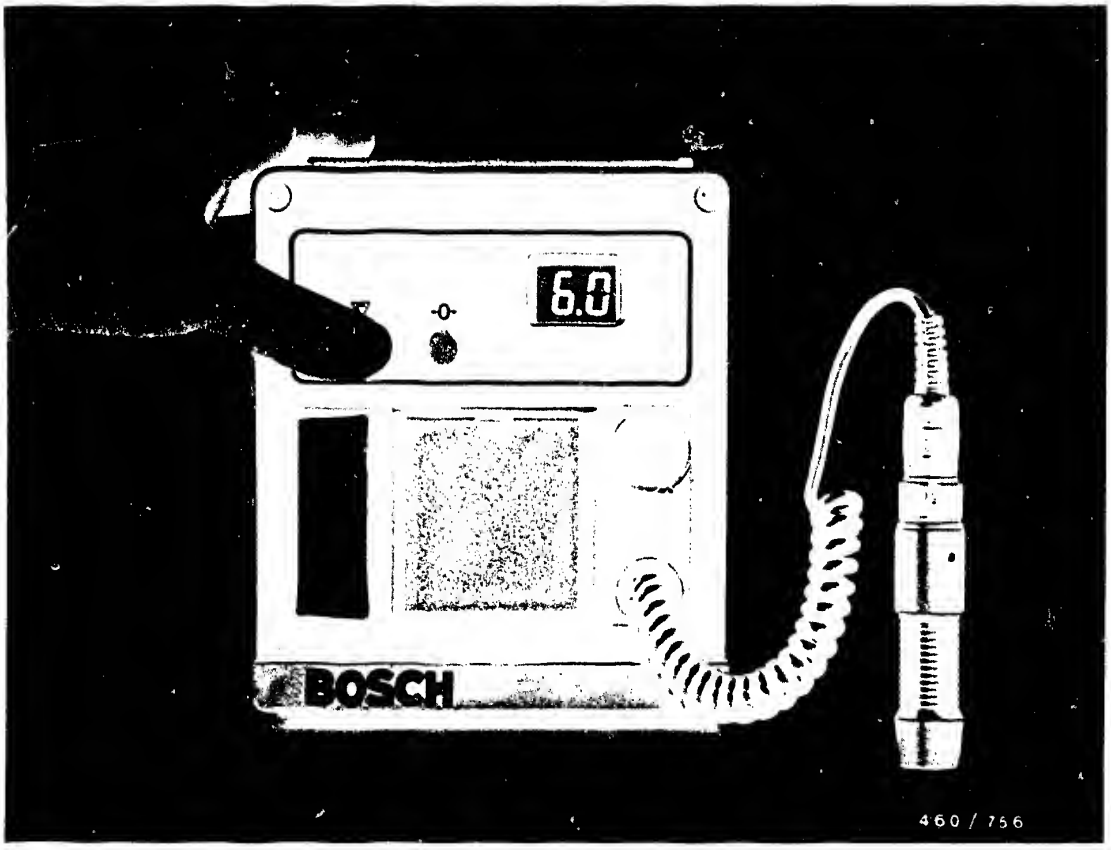
Hold this load for 5 seconds, and then trigger the metering device by pressing on the rubber ball.

Shut off the motor.

N O T E :

In the next step, remember that the exhaust pipe was heated by the running engine.

Remove the filter disc from the metering device.



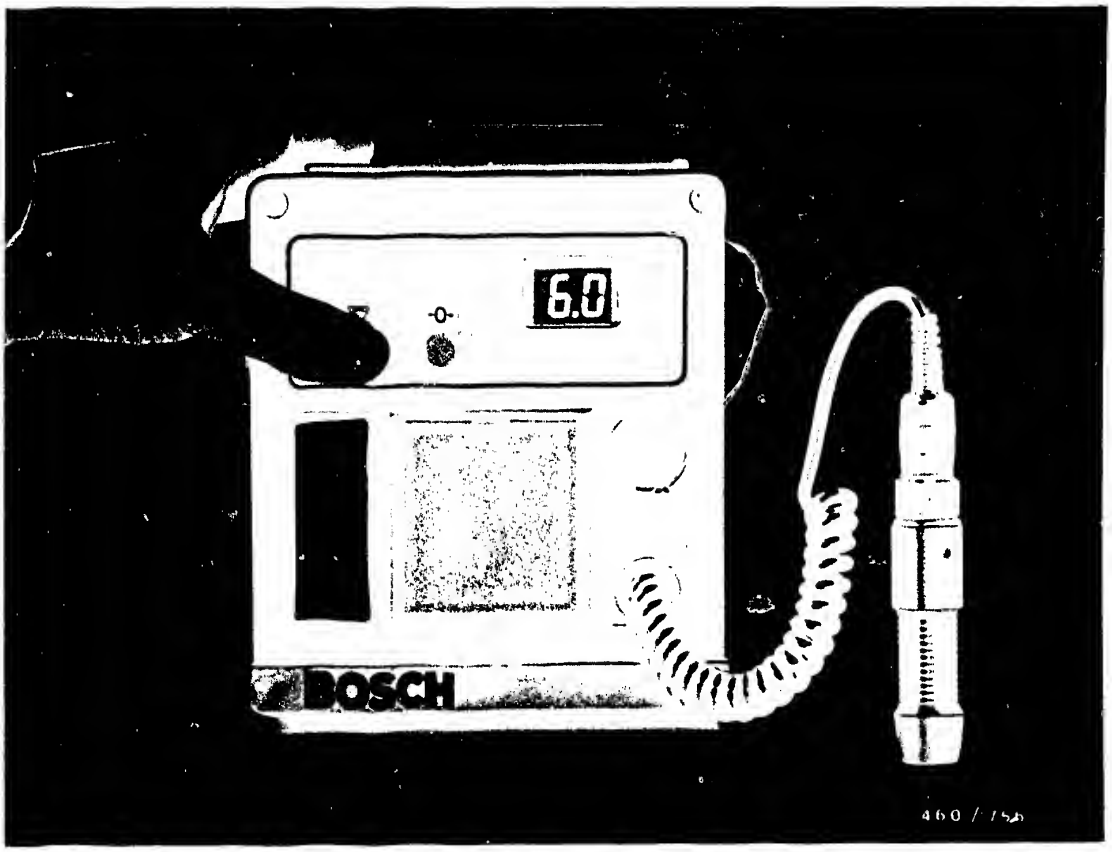
Adjusting the zero point

The zero point adjustment must be made

- before every series of tests
- when there are changes in ambient conditions
- after each cleaning of the lens of the photovoltaic cell adapter.

Press the measuring head on the photovoltaic cell adapter firmly on 5 clean, white filter discs laid one on top of the other.

Press button "0" until the display 0.0 appears.
Release button "0".

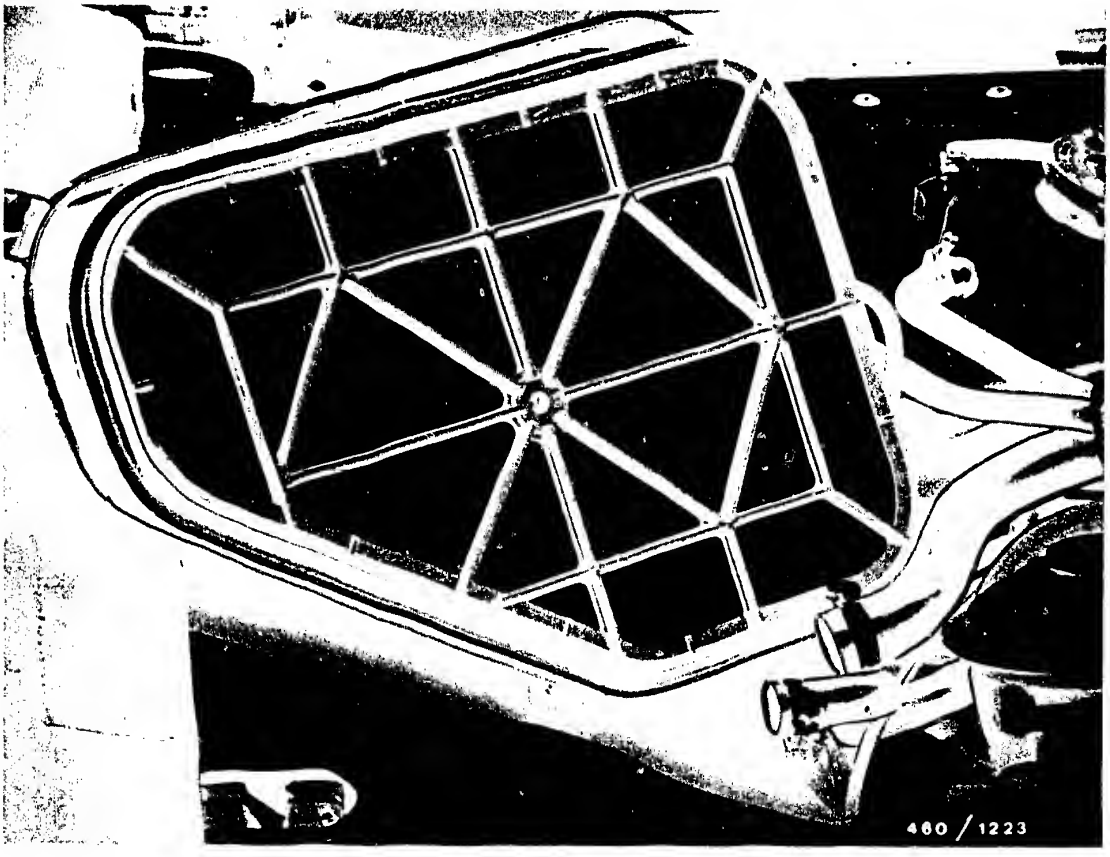


Measurement

Take the filter disc from the metering device and lay it with the soot side up on 3 new filter discs laid one on top of the other.

Press the measuring head vertically against the black surface of the filter disc. At the same time, press button "C" until the smoke number measured appears in the display.

Note:
Both in the zero point adjustment and in the measurement, the measuring head must be put down firmly. (Even a slight tilting can cause errors in measurement.) Compare the smoke number found with the evaluation sheet. In so doing, watch the kW (BHP) data from the vehicle manufacturer.



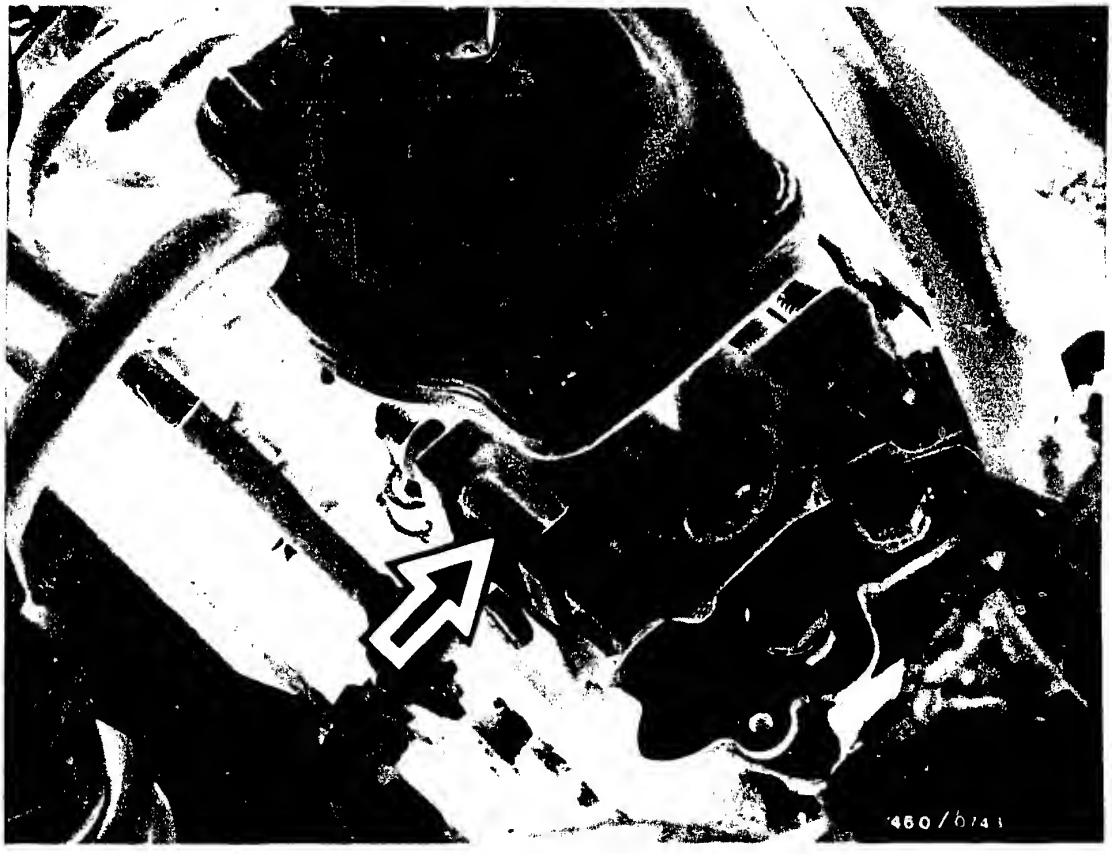
22.3 Checking the air filter

Take out the air filter and subject it to a visual inspection.

Test criteria for the air filter:

- dust-covered air filter
  (check by pounding the air filter)
- oil-covered air filter
- solid particles in the air filter, e.g. foliage

If there is doubt, use a new filter element.



23. Adjusting idle speed

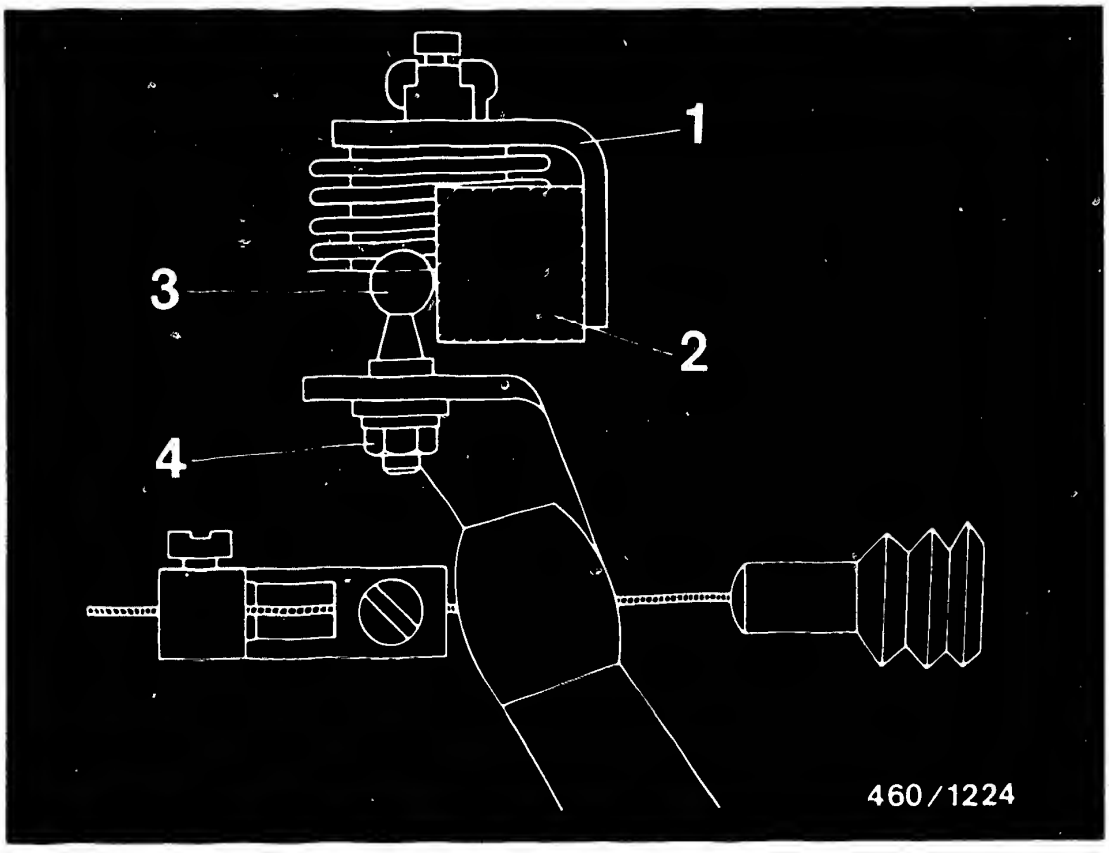
Connect a tachometer (e.g., photoelectric) to the engine.

Adjust engine speed at idle-adjusting screw (see illustration, arrow) to:	800...860 min^{-1}
Engine XD 2S - 2.3 l with air conditioner	780...840 min^{-1}

Note that the engine camshaft and the fuel-injection pump are driven at half the engine speed.

After adjustment, lock the adjusting screw in place and seal it.

Note:
Engine must be at normal operating temperature. Coolant temperature 80°C. Temperature-controlled idle increase must be switched off. Control lever up against idle-adjusting screw (see illustration, arrow).



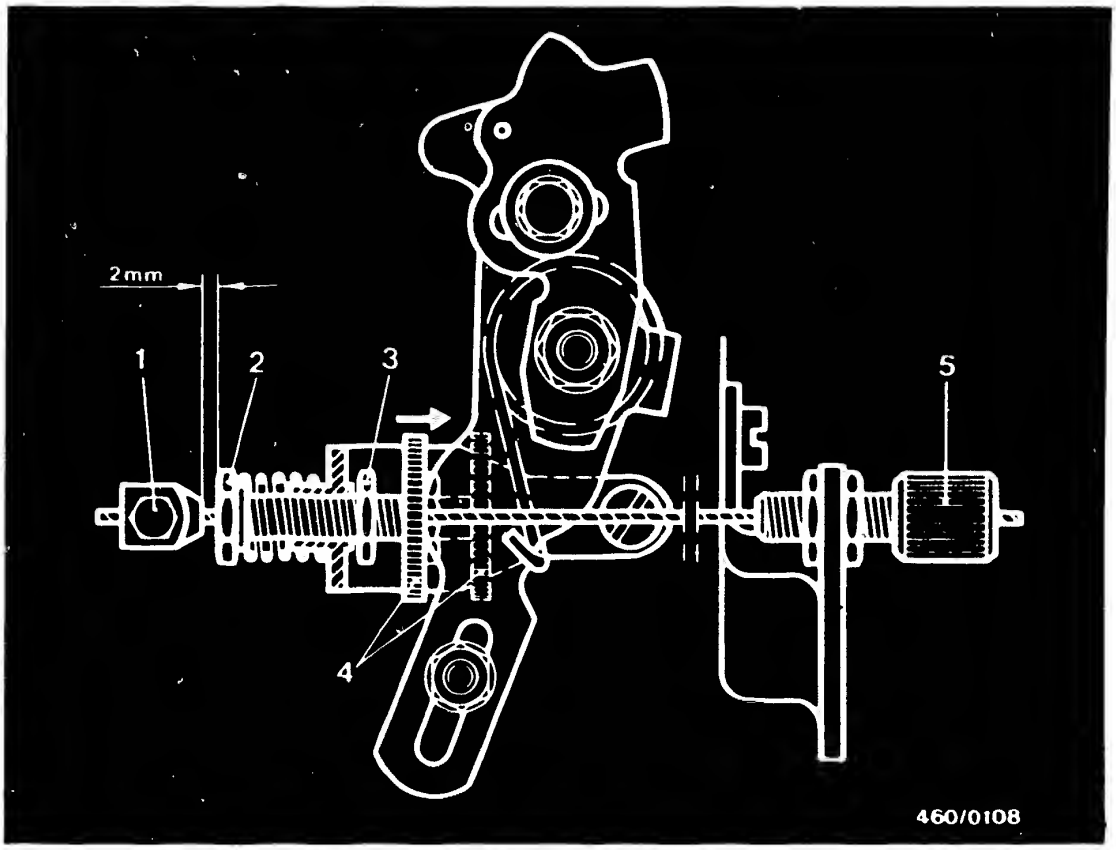
1 = Control lever
2 = Spacer (17 mm)
3 = Ball head
4 = Fastening nut

23.1 Adjust idle increase, engine XD 3T - 2.5 l

Requirements:
- "Warm" idle adjustment O.K.
- Coolant temperature 80°C
- Control lever up against idle-adjusting screw.

Adjusting:
Loosen fastening nut. Insert spacer (17 mm) between ball head and control lever. Press ball stud against spacer and tighten.
Engine speed must be 1050 ... 1150 min^{-1}.

Note:
It is also possible, for example, to use a screw with 17 mm hexagon head as a spacer.



1 = Clamping piece
2 = Hexagon nut
3 = Lock nut
4 = Knurled screw (large)
5 = Knurled screw (small)

23.2 Adjust idle increase, engine XD 2S - 2.3 l

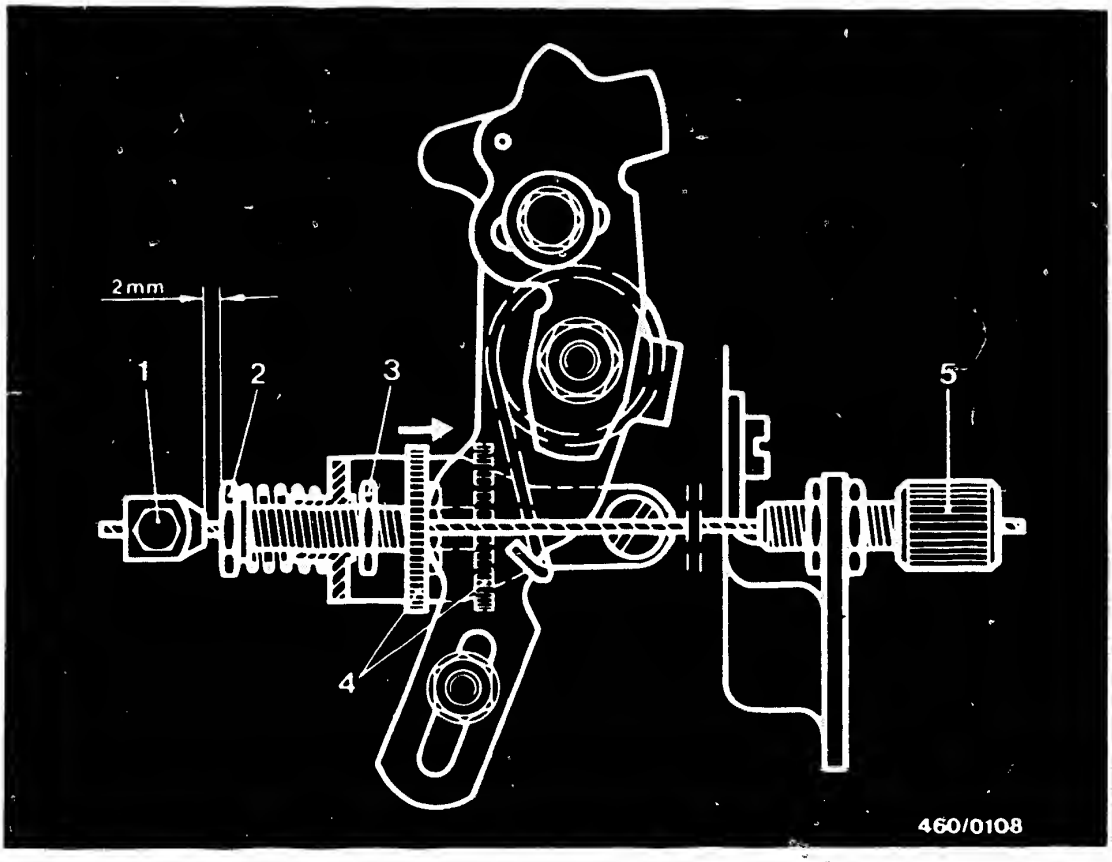
When the idle increase is switched off, there must be a 2 mm gap between the clamping piece and the hex nut.

Make corrections at the clamping piece.

Start the engine and warm it up until the cooling fan starts.

Activate the idle increase.

The engine speed must be 1100 ... 1200 min^{-1}.



1 = Clamping piece
2 = Hexagon nut
3 = Lock nut
4 = Knurled screw (large)
5 = Knurled screw (small)

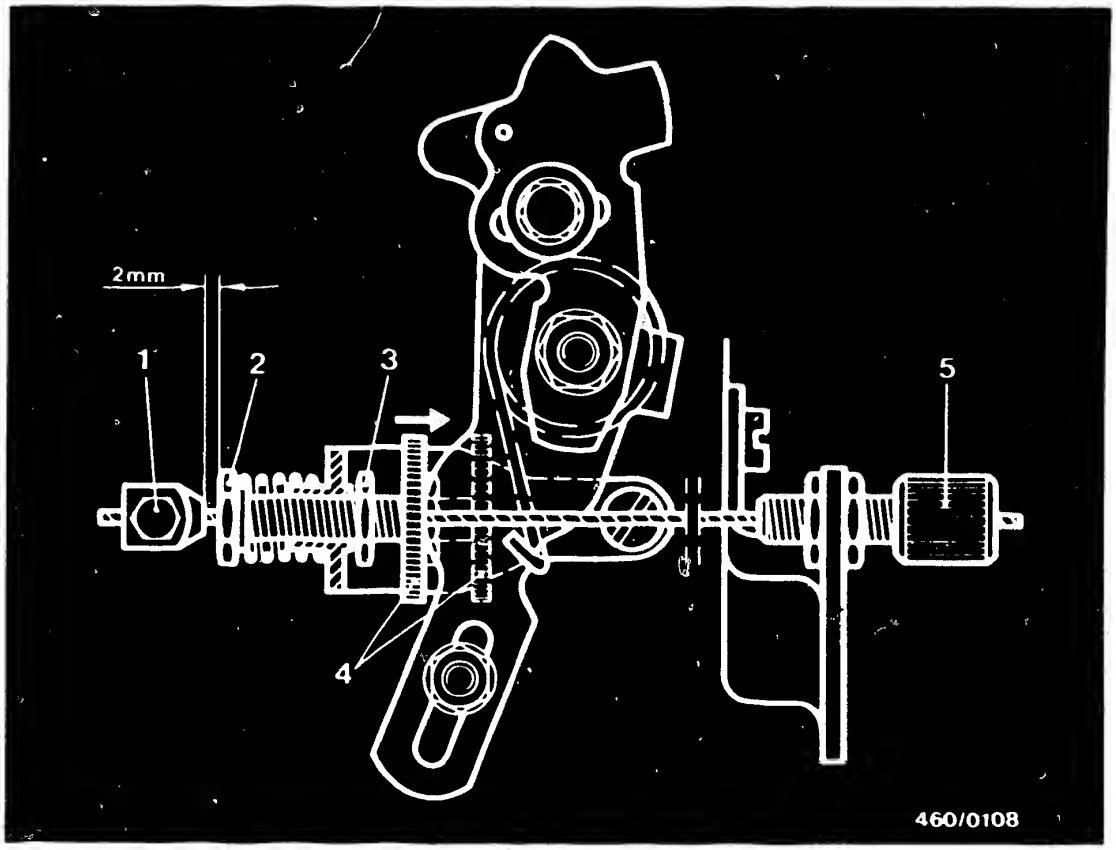
If correction is required, release the locking nut.

Hold the hex nut with a wrench, and adjust the knurled screw (large) until the correct engine speed (1100 ... 1200 min-1) is attained.

Tighten the locking nut. To do so, hold the knurled screw (large) with a wrench.

Switch off the idle increase.

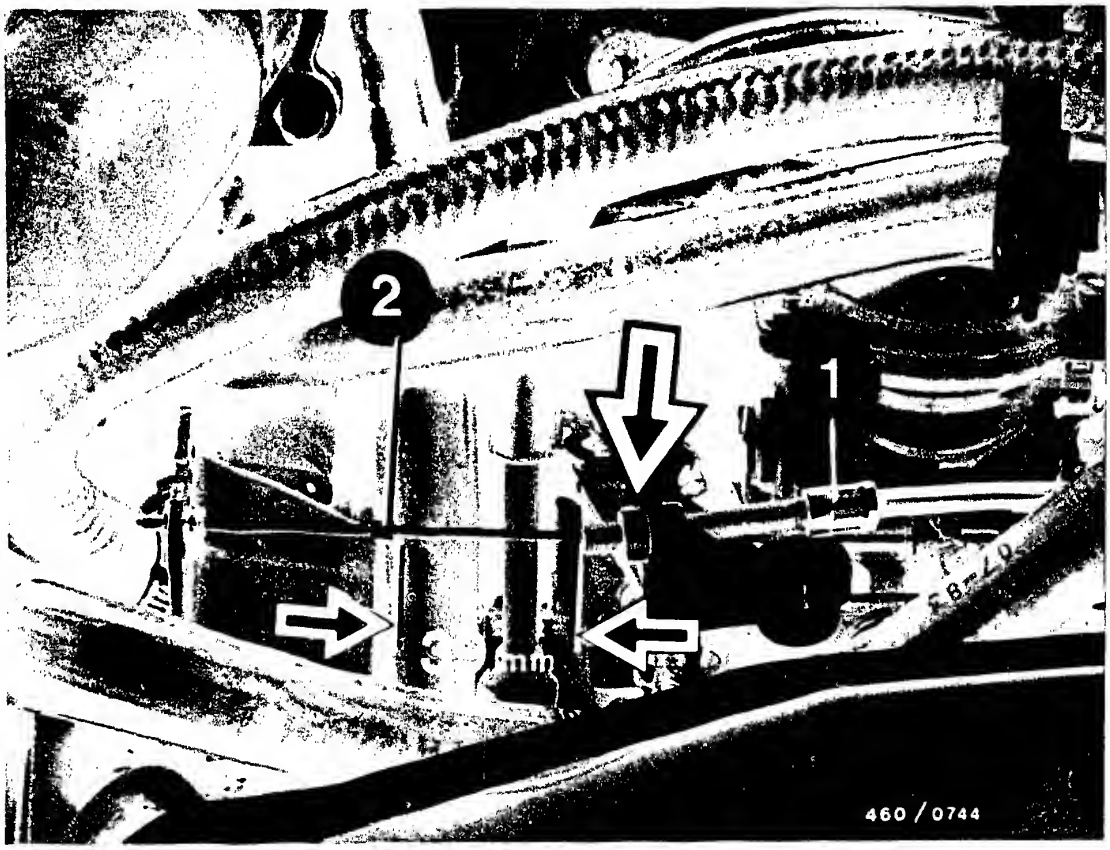
Release the locking nut for the knurled screw (small). Move the knurled screw (small) against the cable sleeve and tighten the locking nut.



1 = Clamping piece
2 = Hexagon nut
3 = Lock nut
4 = Knurled screw (large)
5 = Knurled screw (small)

Check the 2 mm gap between the clamping screw and the hex nut.

If need be, correct the gap using the clamping piece.



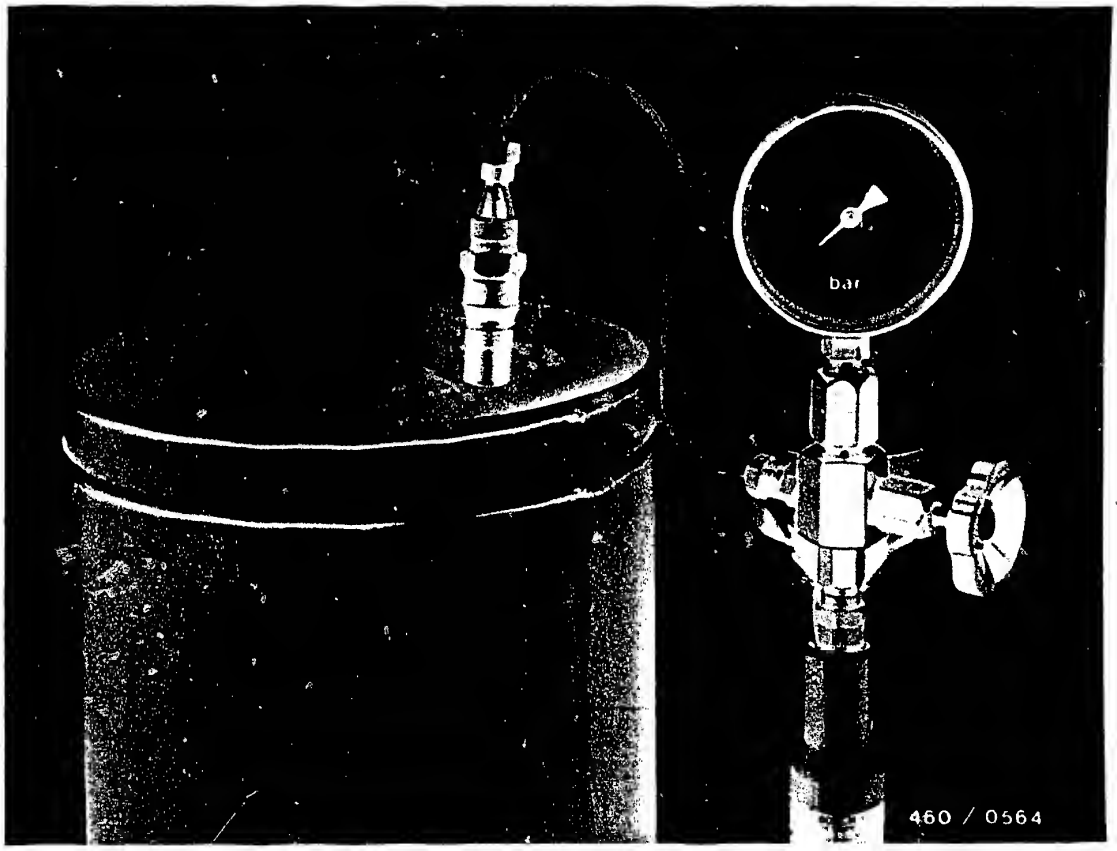
24. Kick-down adjustment

Prerequisite:

- Engine at normal operating temperature, temperature of cooling water + 80°C.

Adjustment:

- Press the accelerator pedal down to the kick-down point.
- Release the locking nuts (arrow) and adjust the guide sleeve (1) to a distance of 39 mm from the cable clamp (2).
- Tighten the locking nuts, check the setting.



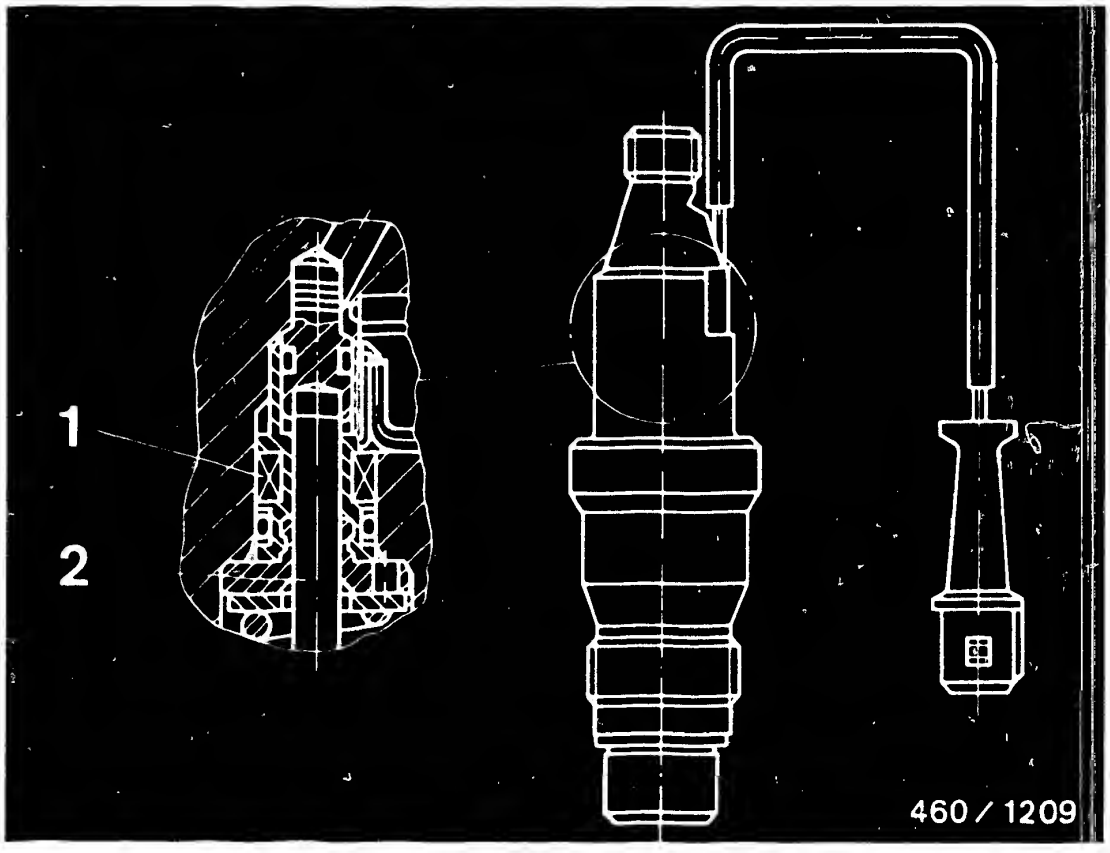
25. Checking fuel-injection nozzles

Take the fuel-injection nozzles out.

Nozzle tester EFEP 60 H, 0 681 200 502, is used for the test.

Mount the fuel-injection nozzle and the nozzle-holder assembly on the nozzle tester.

To be certain that the nozzle is not clamped too tightly, move the manual lever on the nozzle tester strongly several times with the pressure gauge switched off (approx. 4 to 6 downward movements second).



1 = Needle-movement sensor 2 = Spindle

25.1 Nozzle-holder assembly with induction-type needle-movement sensor (cylinder 2)

Exclusively a correction of the opening pressure is allowable by the after-sales service.

If the nozzle is defective, replace the complete nozzle-holder assembly.

To do this, use special shims (larger diameter of central bore).

Principle of nozzle-movement sensor

An applied DC voltage is regulated so that there is a constant current independent of changes in temperature.

The spindle (2) changes a gap in this magnetic circuit, which leads to a change of the magnetic flux and thus to a signal voltage which is induced in the coil.

The amplitude of the signal voltage is proportional to the rate of change of flux which, in turn, is determined by the speed of the spindle and by the geometry in the gap.

The signal curve is considerably influenced by the sensor gap. The determining factors in this are:

Holder
Adjusting pin
Spindle
Intermediate washer
Nozzle

When replacing nozzle parts, there is a change in the sensor gap, which leads to a change in the signal voltage and to incorrect evaluation by the control unit.

Therfore, it is n o t allowable to replace parts on the nozzle.

Instructions:

When checking fuel-injection nozzles, make certain that the fuel jet does not strike your hands, because, due to the high pressure, the fuel penetrates into the skin and can cause blood poisoning.

For testing, use pure calibrating oil per ISO 4113 or clean diesel fuel.

Test criteria:

- Opening pressure
- Leaks
- Chatter
- Spray pattern

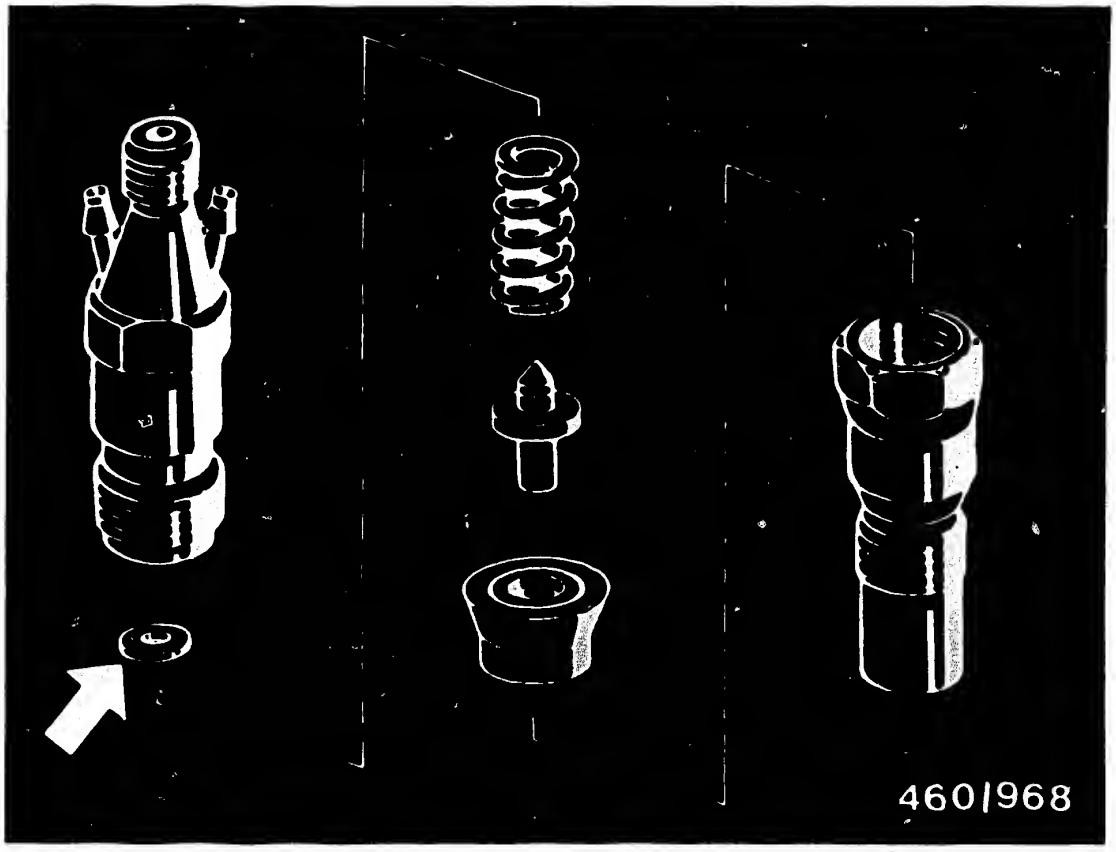
25.2 Checking opening pressure

Open the spray valve on the pressure gauge by approx. 1/4 turn.

Slowly press down the manual lever on the nozzle tester (increased pressure on the pressure gauge).

Observe the pressure at which the needle of the pressure gauge stops (nozzle does not chatter), or where the pressure drops off suddenly (nozzle chatters).

The maximum pressure attained in so doing is the opening pressure.



If there is a deviation from the specified value, correct the nozzle opening pressure by means of compensating washers behind the pressure spring (arrow).

Specified value: 150 + 5 bar

thicker washers = higher nozzle opening pressure
thinner washers = lower nozzle opening pressure

Changing the spring travel by +/- 0.05 mm changes the nozzle opening pressure by approx. 5.0 bar.

25.3 Checking for leaks

Open the shutoff valve on the pressure gauge by approx. 1/4 turn.

Dry off the lower portion of the nozzle and nozzle-holder assembly. (Blow it dry with air.)

Slowly press down on the hand lever until the pressure gauge indicates 20 bar less than the opening pressure as read above. The nozzle does not leak if there is no drop dripping from the nozzle opening within 10 seconds.

If a drop drips off, take the nozzle-holder assembly combination apart and clean it.

If the leak is still there, take out and replace the nozzle.
It is not permissible to remachine the parts of the nozzle.

Note:
Striation on the holder assembly and the intermediate disc can be machined off provided the necessary care is taken (other than during the warranty period).

25.4 Chatter test, Evaluation of the spray pattern

General information:

When evaluating nozzles, make a distinction between new and used nozzles.

Switch the pressure gauge off.

New nozzles:

The chatter test makes it possible to test for ease of movement for the nozzle needle in the nozzle body by means of listening. If the nozzle does not chatter in spite of cleaning, it is to be replaced with a new nozzle. In the chatter test, the shape of the spray is of no significance. A spray pattern corresponding to specifications is generally present only with new nozzles.

Used nozzles:

The chatter behavior of the nozzle deteriorates due to wear in the area of the seat. When the lever is moved quickly, the nozzle must chatter audibly and/or spray a well-atomized spray.
In the case of used nozzles, the spray pattern can deviate from the ideal shape from a new nozzle. The spray pattern from such nozzles however can be perceptibly improved by appropriate cleaning.

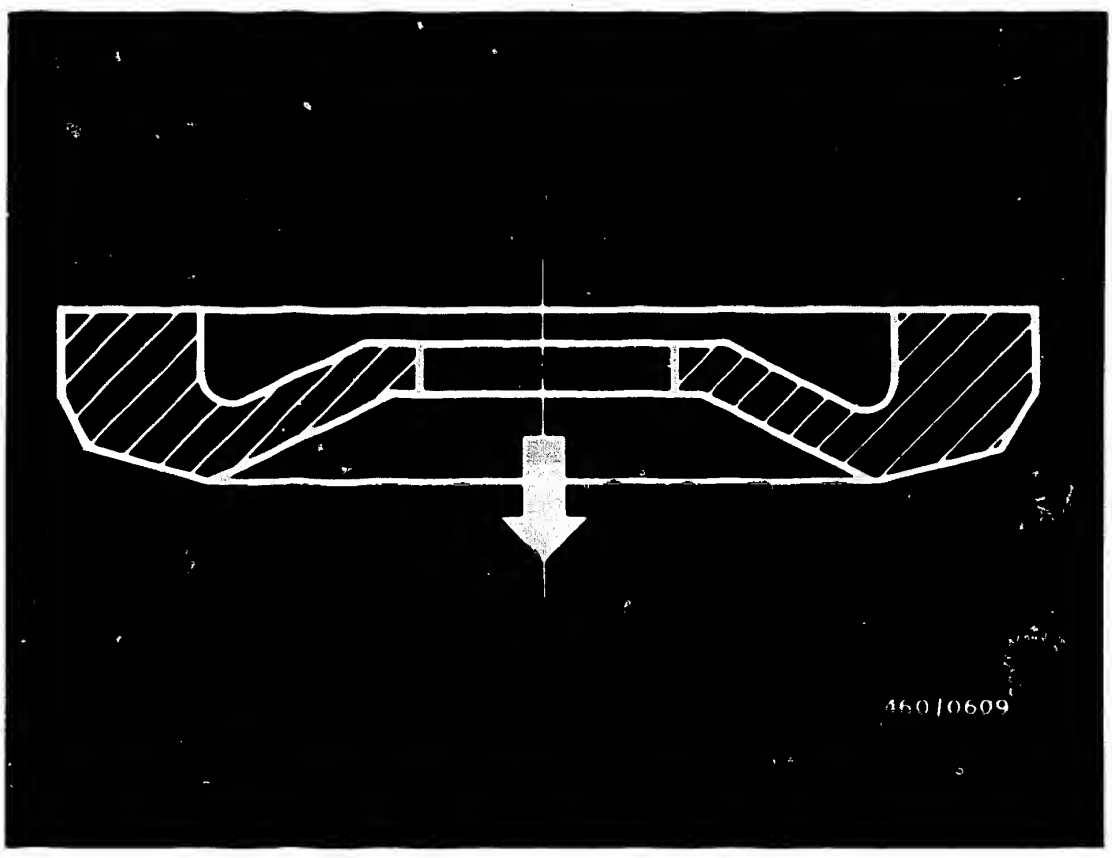
25.5 Chatter test and spray test

These are pintle nozzles, with a throttle effect, that are installed in all types of engines.

These nozzles have a special base shape and an additional spray hole through which the preliminary spray comes out.

Chatter test:
Due to its special construction, this nozzle chatters very softly. A chatter test is possible on it only when the hand lever is being moved between 1 and 2 downward movements per second. When testing speed is increased, the chattering stops. The calibrating oil then comes out of the nozzle with a hissing sound. Only when the hand lever is moved suddenly and quickly (approx. 4...6 downward movements per second) does the nozzle chatter with a high whistling tone.

Spray pattern: (valid for new nozzles only)
When tested at a low speed, the majority of the fuel delivered must come out through the preliminary spray hole at the side well-atomized and without the formation of heavier strands. Evaluation of the main jet is possible only when the hand lever is moved quickly (approx. 4...6 downward movements per second). The spray must be closed and well atomized.



25.6 Putting in fuel-injection nozzles

Before putting the fuel-injection nozzles in, insert a new thermal protection disc right side up into the cylinder head for shielding and compensation of tolerances (seal cone 150° in the direction shown by the arrow).
Then screw the nozzle holder into the cylinder head and tighten to 70 Nm.

Note:
If the tightning torque is exceeded, the nozzle needle can jam.

Tighten union nuts for the fuel-delivery lines to 25 Nm.

25.7 Running-time electronics

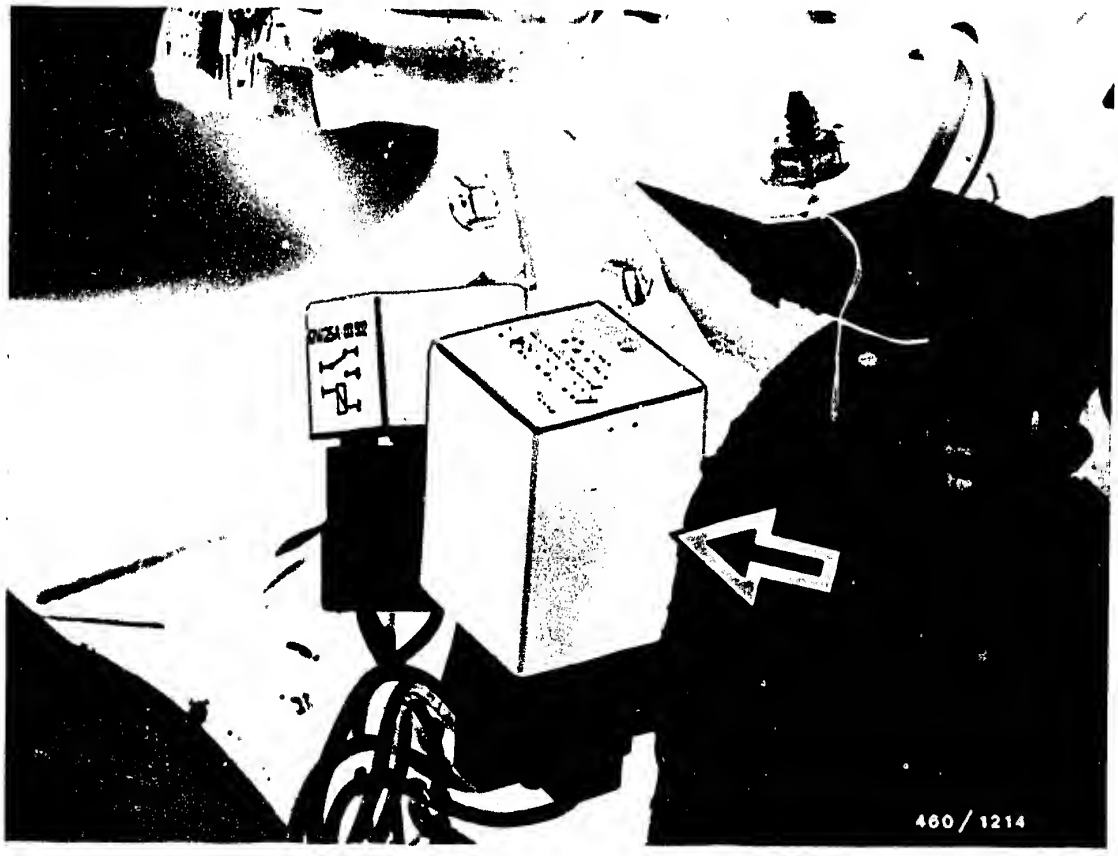
The control unit of the closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal is additionally provided with a running-time electronic unit which has the task of compensating for the absence of carbon-fouling on new nozzles (less exhaust is recirculated when new).

Depending on the operating time (running time) of a nozzle, there is a change in the degree of carbon-fouling and, accordingly, in the flow rate. Consequently, the duration of injection becomes longer as the carbon-fouling increases; this in turn influences the exhaust emissions.

To compensate for the absence of carbon-fouling, the injection cycles are detected by a needle-movement sensor (integrated in the nozzle holder) and are added up in a counting memory (in the control unit). When the max. counter status is reached, a fuse in the running-time electronics is blown by the control unit. This changes the exhaust-gas recirculation rate.

The duration of compensation is dependent on the speed and mileage of the vehicle.

When all fuses of the running-time electronics have been blown one after the other, there is no longer any correction.

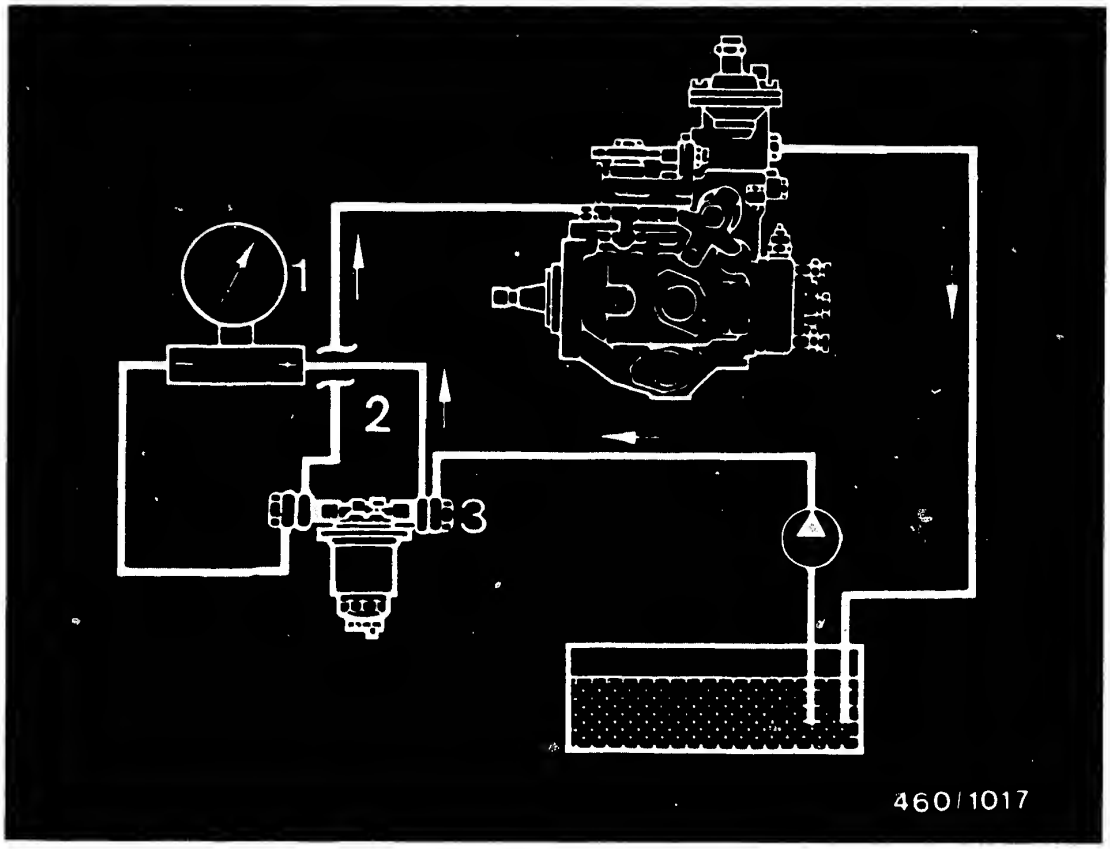


The fuses of the running-time electronics are grouped together in a fuse box (see illustration, arrow) which is situated next to the coolant expansion tank.

Notes on installing new nozzles

- Vehicle with engine XD 2S - 2.3 l:
  Replace fuse box.

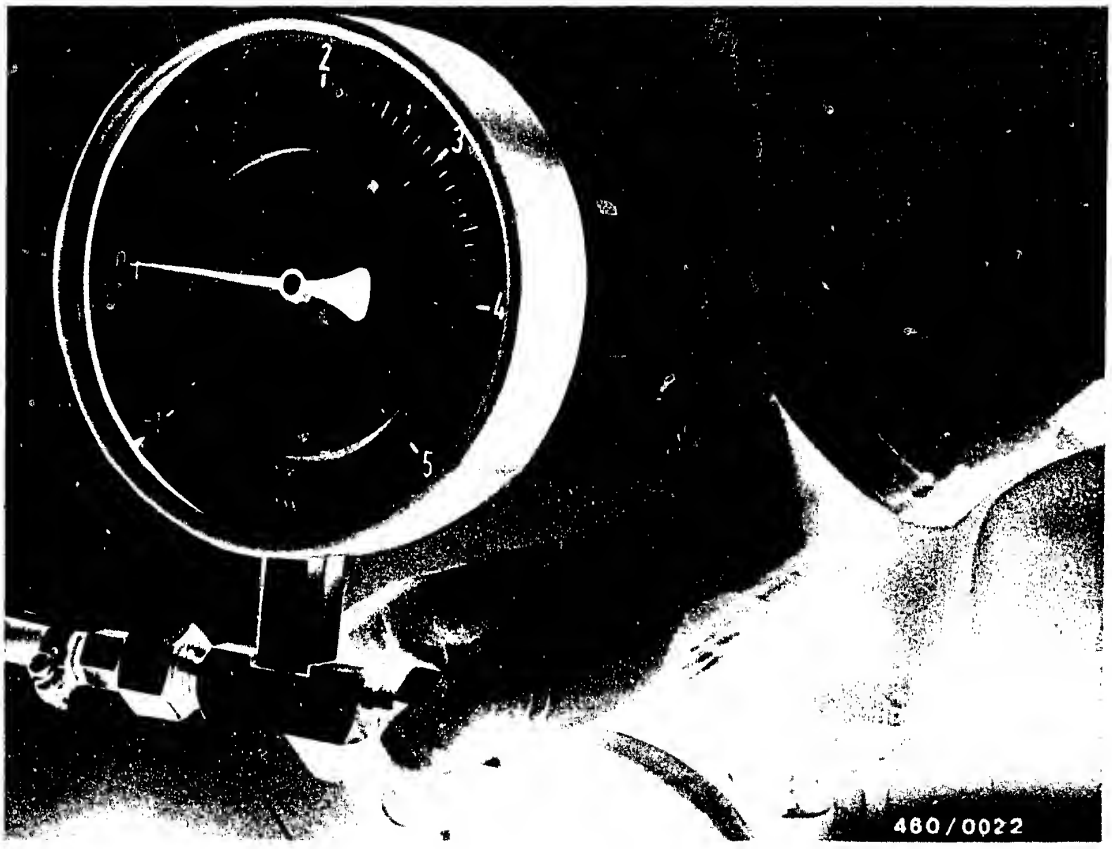
- Vehicle with engine XD 3T - 2.5 l:
  Replace fuse box and re-activate counting memory (in control unit) by briefly disconnecting the positive pole of the battery.



1 = Differential pressure gauge
2 = Filter outlet
(Use inlet union and overlong inlet-union screw 2 443 456 020.)
3 = Filter inlet
(Use inlet union and overlong inlet-union screw 2 443 456 020.)

26. Connection diagram for filter test (differential pressure test)

Connect the differential pressure gauge to the fuel filter using appropriate connectors.

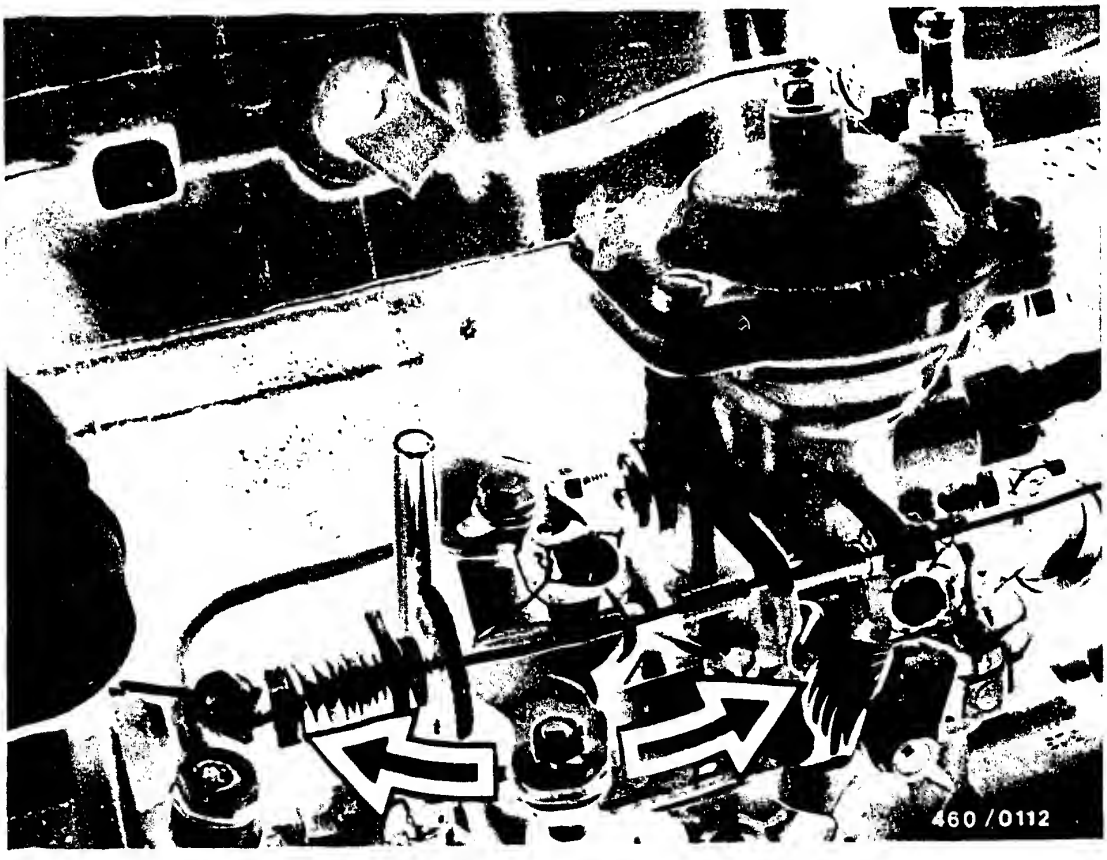


Connect the differential pressure gauge with the side identified with (+) to the fuel filter inlet.

Mount the (-) connection of the pressure gauge on the filter outlet.

Watch the connection diagram.

Run the engine until it is assured that there is no air in the fuel system.



Move the fuel-injection pump control lever (approx. 1 second) from the idle stop to the max. speed stop.

Release the control lever and read the differential pressure on the pressure gauge.

The differential pressure must not exceed max. 0.3 bar. If that value is exceeded, take out and replace the filter.
Remove test connections.

If need be, bleed the fuel system.

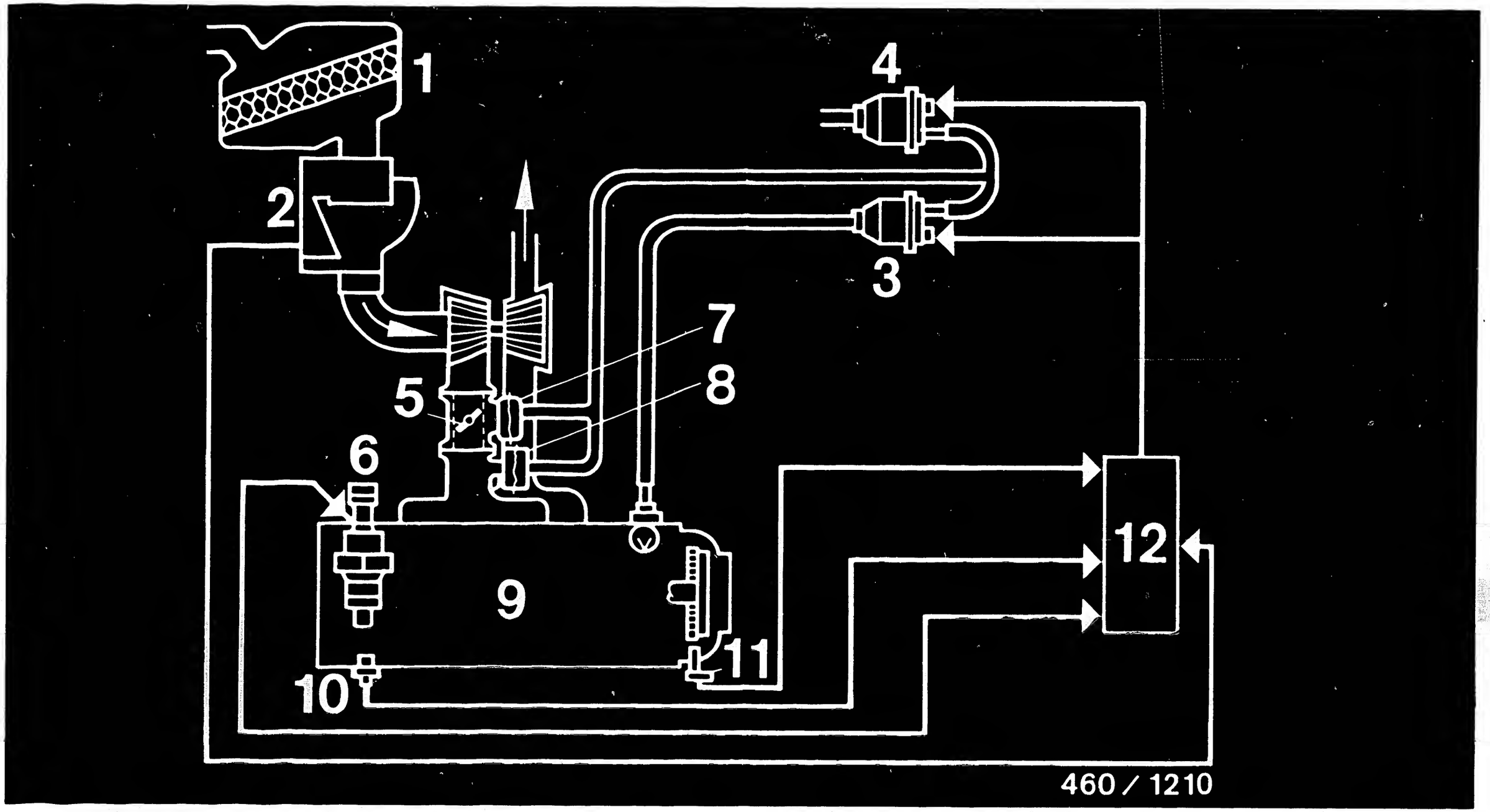
27. Test closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal using universal test adapter

27. 1 Necessary test equipment

Universal test adapter	ETT 018.01	0 684 101 801
Adapter lead		1 684 463 166
Multimeter		Commercially available

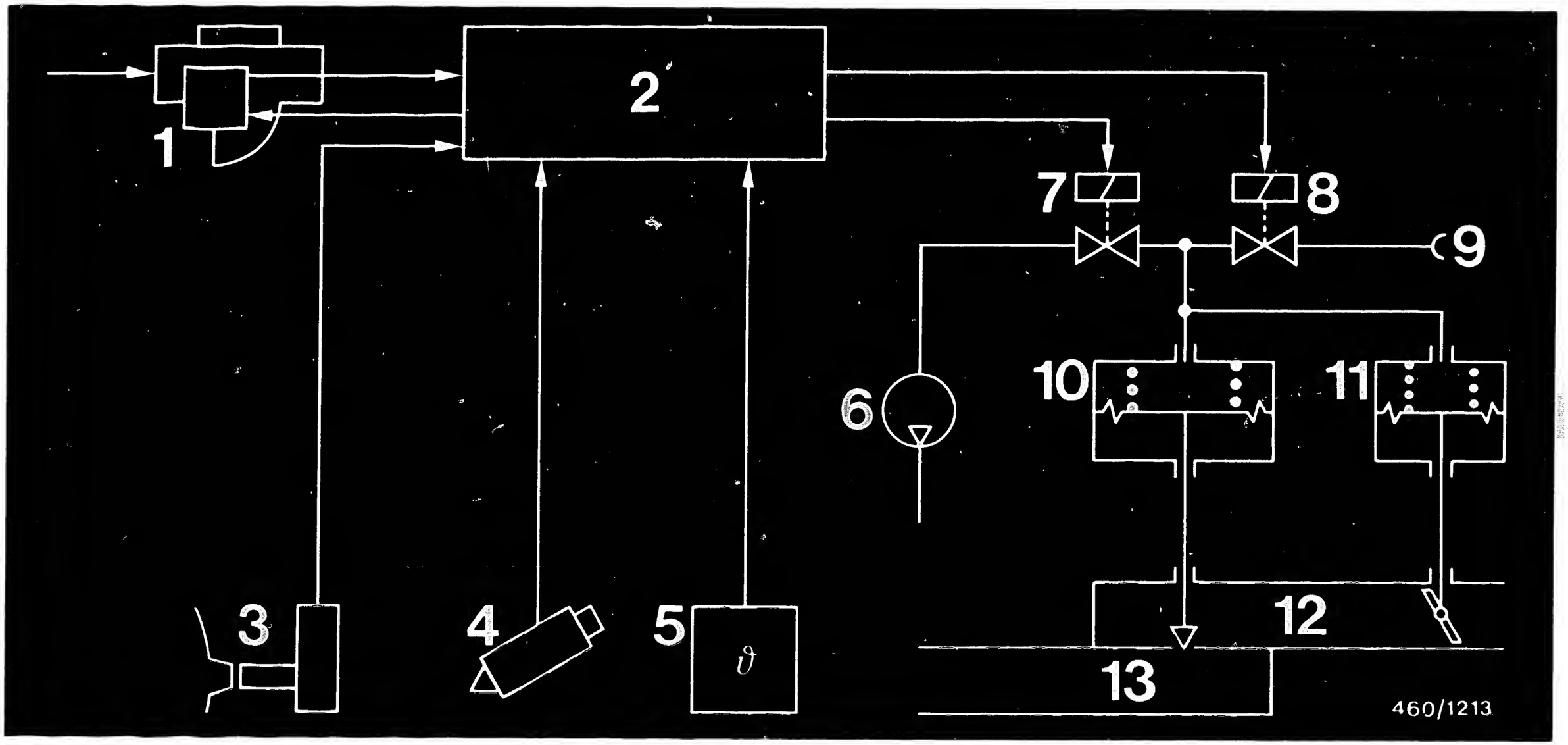
Note:

The following section begins with an introduction to the operating principle of the closed-loop-controlled exhaust-gas recirculation system with duration-of-injection signal.



27.2 System circuit diagram of closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal

1 = Air filter
2 = Air-flow sensor
3 = Vacuum solenoid-operated valve
4 = Atmosphere solenoid-operated valve
5 = Throttle valve
6 = Injection nozzle with needle-movement sensor
7 = Throttle-valve vacuum unit
8 = EGR valve
9 = Vacuum pump (engine)
10 = Temperature sensor
11 = Engine-speed sensor
12 = Control unit



27.3 Block diagram of closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal

1 = Air-flow sensor
2 = Control unit
3 = Engine-speed sensor
4 = Injection nozzle with needle-movement sensor
5 = Temperature sensor
6 = Vacuum pump (engine)
7 = Vacuum solenoid-operated valve
8 = Atmosphere solenoid-operated valve
9 = Atmosphere connection
10 = Exhaust-gas recirculation valve
11 = Throttle-valve assembly
12 = Charge-air pipe
13 = Exhaust pipe

Operating principle of closed-loop-controlled exhaust-gas recirculation system

Through the interaction of a vacuum-controlled EGR valve with a throttle-valve assembly some of the exhaust gas is recirculated to the charge-air pipe.

Operating principle of closed-loop-controlled exhaust-gas recirculation system (continued)

Afterburning reduces the combustion temperature and the emission of oxides of nitrogen (NO_x).

The EG rate is adapted to the rate of injection by the control unit which processes the following input signals: duration of injection, engine speed, temperature and air flow.

The set value which is established from these input variables is fed to a 3-point controller (installed in the control unit).

This controller alternately energizes the solenoid-operated valves for vacuum and atmospheric pressure until, as a result of corresponding adjustment of the EGR valve and of the throttle-valve assembly, the same actual value is fed back to the controller from the air-flow sensor.

Note:
In the event of failure of the needle-movement sensor/ engine-speed sensor, the exhaust-gas recirculation system is inoperative.

27.4 Function table of closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal

	Rising EGR rate	Falling EGR rate	No EGR	Stabilized control
Exhaust-gas recirculation	Yes Tendency rising	Yes Tendency falling	No	-
Solenoid-operated valve (vacuum)	Energized	De-energized	De-energized	De-energized
Solenoid-operated valve (atmosphere)	De-energized	Energized	Energized	De-energized
Throttle valve	Closing Tendency falling	Opening Tendency rising	Open	Half-closed at equilibrium
EGR valve	Opening Tendency rising	Closing Tendency falling	Closed	Half-open at equilibrium

The working range of the exhaust-gas recirculation system is limited to the following operating conditions: water temperature > 48°C and engine speed 600...3000 min^{-1}.

27.5 Notes on the following trouble-shooting program

Using the universal test adapter and other suitable test equipment, the following trouble-shooting chart is intended to enable the workshop employees to quickly detect causes of trouble.
The program is divided into three rows of boxes:
The boxes in the left-hand row represent the most favorable sequence of the test steps. At the same time, each box contains all the necessary information on how to use the universal test adapter and measuring instrument, test conditions, test procedure and test specifications.

The center row contains the necessary instructions on each test step for finding and remedying the fault.

The right-hand row provides supplementary information - if necessary - by means of illustrations/sketches.

The sequence of the test steps represents the most favorable procedure. Always perform the entire program since the individual test steps build on each other. Branching to the center row of boxes is only necessary if, in a test step, the test specifications or functional requirements are not met.

27.6 Connection of universal test adapter

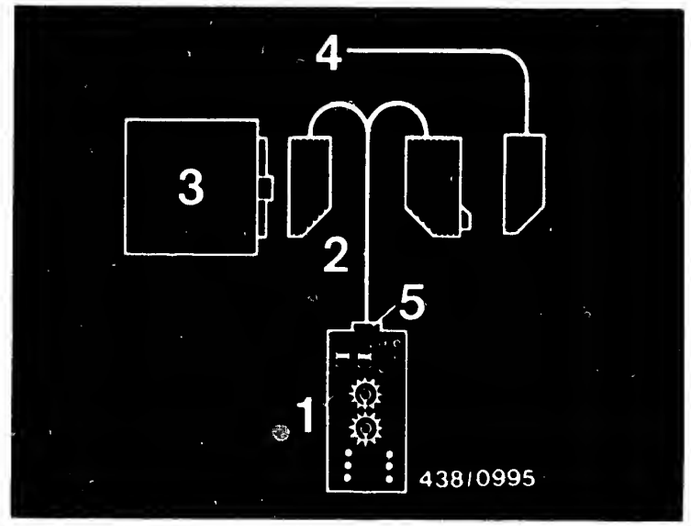
The individual test steps are selected by two program-selector switches (one for voltage measurements, the other for resistance measurements). Each program-selector switch has 24 test settings, only some of which, however, are occupied for the closed-loop-controlled exhaust-gas recirculation system with duration-of-injection signal.

If, during a test, a fault is found, the test must be repeated after the fault has been remedied.

- Before testing with the universal test adapter, check all multiple plug-in connections for loose contacts.
  Clean contacts if dirty or corroded.
- Watch for receptacles that have been pushed back.
  If necessary, bend back the locking tab and press the receptacle as far as it will go into the plug housing; locking tab latches.
- Suspicion of line breaks in case of kinking and pinching.

Disconnect multiple plug from control unit (push back detent and first of all hinge up plug on side of detent). Connect plug to terminal strip of test lead of universal test adapter.

The multiple plug of the test lead is intended for connection to the control unit. However, it may only be connected for certain tests in the following test chart. Follow the corresponding instructions in each test step.

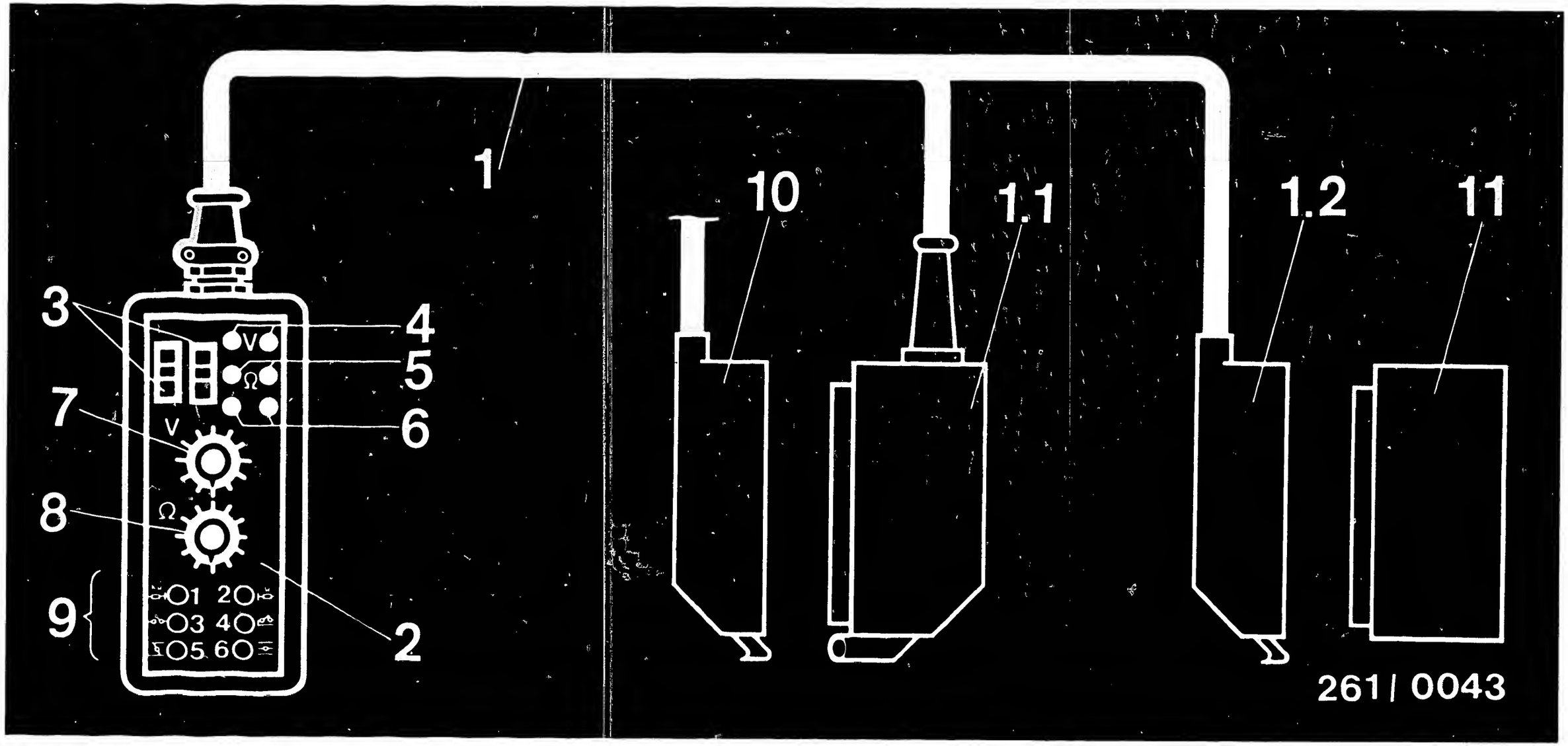


1 = Universal test adapter
2 = System adapter lead
3 = Control unit
4 = System wiring harness
5 = Pin terminal

Important:

Always switch off the ignition before connecting or disconnecting the control unit.

Connect multimeter (e.g. Miselco Master 50 K) in accordance with manufacturer's instructions to the appropriate test sockets of the universal test adapter (V, Ω, 1-2 for current measurements).



27.7 Construction and use of universal test adapter

1 = Test lead - duration-of-injection - exhaust-gas recirculation 1 684 463 166
1.1 = Connection to wiring harness
1.2 = Connection to control unit
2 = Universal test adapter ETT 018.01 - 0 684 101 801
3 = Test wells for motortester (not used)
4 = Test sockets for voltage measurement
5 = Test sockets for resistance measurement
6 = Test sockets for current measurement
7 = "V" program-selector switch
8 = "Ω" program-selector switch
9 = Button panel for simulation of operating conditions
Button 1 = Simulation of engine "cold" (-20°C)
Button 2 = Simulation of engine "warm" (approx. 80°C)
Button 3 = Not occupied
Button 4 = Not occupied
Button 5 = EGR operation
Button 6 = EGR operation
10 = Multiple plug (vehicle wiring harness)
11 = Control unit

TEST STEP 1

Component/Function:

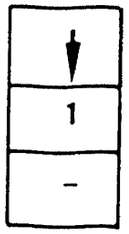
Engine-speed sensor - short circuit to ground

Operation/Switch positions:

Prog.-selec. switch "V"

Prog.-selec. switch "Ω"

Test button



Switch off ignition.
Disconnect plug from control unit.

Measuring equipment:

Multimeter

Measuring range: x 10 000 Ω
Connection: Ω sockets

Test specification: ∞ Ω

Test specification obtained?

no

Trouble-shooting:

Malfunction:
Resistance not ∞ Ω.

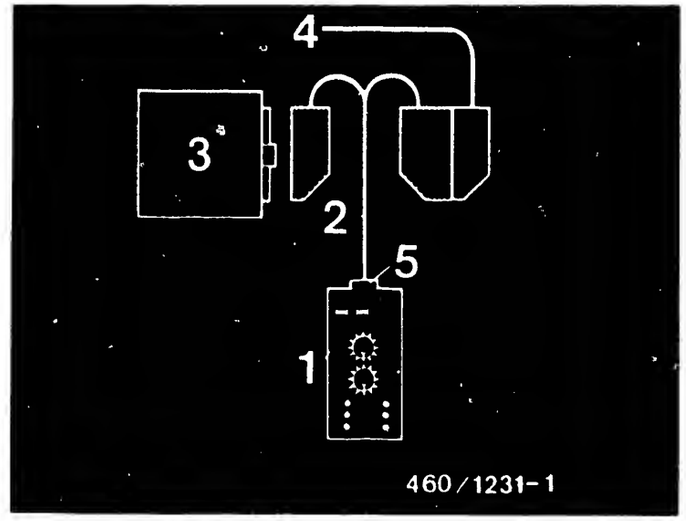
Fault elimination:

1. Check lead 1 from multiple plug to engine-speed sensor for short circuit to ground.

2. Engine-speed sensor short circuit to ground, replace engine-speed sensor.

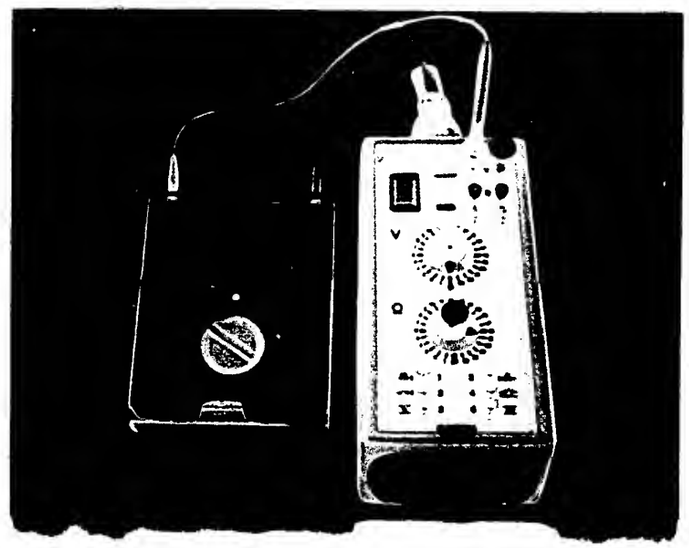
yes

Continue testing with next test step



1 = Universal test adapter
2 = System adapter lead
3 = Control unit
4 = System wiring harness
5 = Round-pin plug

Test setup:
Multimeter and universal test adapter



Installation position of components

Engine block on right
(on turbocharger side)

TEST STEP 2

Component/Function:
Needle-movement sensor - short circuit to ground

Operation/Switch positions:
Prog.-selec. switch "V"

Prog.-selec. switch "Ω"

Test button

↓
2
-

Plug disconnected from control unit.

Measuring equipment:
Multimeter

Measuring range: x 10 000 Ω
Connection: Ω range

Test specification: ∞ Ω

Test specification obtained?

no →

Trouble-shooting:

Malfunction:

Resistance not ∞ Ω.

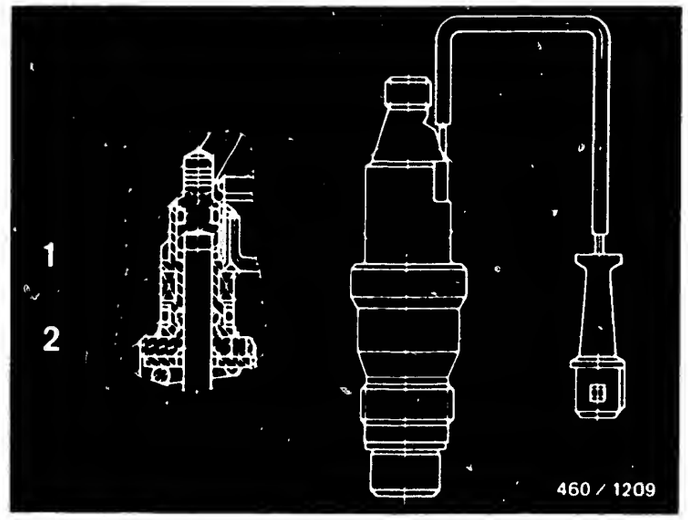
Fault elimination:

1. Check lead 2 from multiple plug to needle-movement sensor for short circuit to ground.

2. Needle-movement sensor short circuit to ground, replace nozzle-holder assembly.

yes ↓

Continue testing with next test step



1 = Needle-movement sensor
2 = Spindle

Installation position of components:

Nozzle-holder assembly - cylinder 2.

See illustration for installation pos. of needle-movement sensor in nozzle-holder assembly.

TEST STEP 3

Component/Function:
Engine-speed sensor internal resistance

Operation/Switch positions:

Prog.-selec. switch "V" ↓

Prog.-selec. switch "Ω" 3

Test button -

Plug disconnected from control unit.

Measuring equipment:

Multimeter

Measuring range: x 1 Ω
Connection: Ω sockets

Test specification: 55...65 Ω

Test specification obtained?

no →

Trouble-shooting:

Malfunction:

Resistance ∞ Ω.

Fault elimination:

1. Check leads 1 and 14 from multiple plug to engine-speed sensor for open circuit.

   Eliminate open circuit.

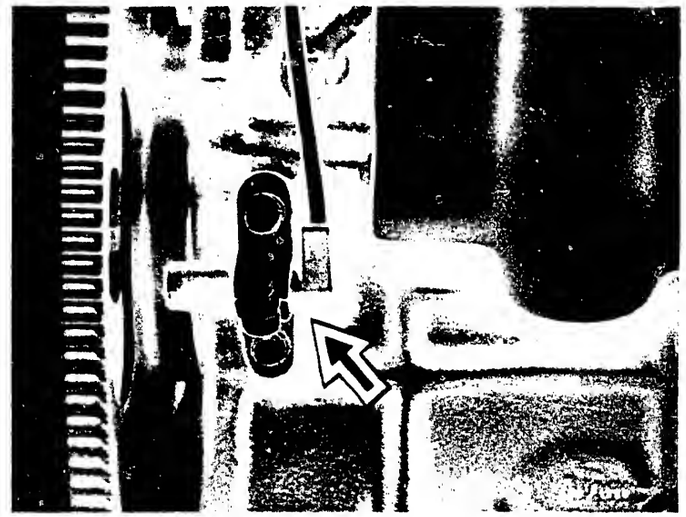
2. Engine-speed sensor defective, replace.

Malfunction:
Resistance not within tolerance

Fault elimination:
Engine-speed sensor defective - replace.

yes ↓

Continue testing with next test step



Arrow = Engine-speed sensor

Installation position of components:

Engine block on right, on turbocharger side (see illustration).

TEST STEP 4

Component/Function:
Needle-movement sensor internal resistance

Operation/Switch positions:

Prog.-selec. switch "V"	↓
Prog.-selec. switch "Ω"	4
Test button	-

Plug disconnected from control unit.

Measuring equipment:

Multimeter

Measuring range: x 10 Ω
Connection: Ω sockets

Test specification: approx. 20°C: 90...110Ω
approx. 80°C. 111...135Ω

Test specification obtained?

no

Trouble-shooting:

Malfunction:

Resistance ∞ Ω.

Fault elimination:

1. Check leads 2 and 15 from multiple plug to needle-movement sensor for open circuit.

   Eliminate open circuit.

2. Needle-movement sensor defective, replace nozzle-holder assembly.

Malfunction:

Resistance not within tolerance

Fault elimination:

Needle-movement sensor defective, replace nozzle-holder assembly.

yes

Continue testing with next test step

Installation position of components:

Nozzle-holder assembly - cylinder 2.

TEST STEP 5

Component/Function:
Water temperature switch internal resistance

Operation/Switch positions:

Prog.-selec. switch "V"	↓
Prog.-selec. switch "Ω"	5
Test button	1/2

Plug disconnected from control unit.

Measuring equipment:

Multimeter
Measuring range: 10 000 Ω or
x 1 Ω
Connection: Ω sockets

Test specification:

Engine cold (button 1) ∞ Ω
Engine warm (button 2) 0...10 Ω

Test specifications obtained?

no →

Trouble-shooting:

Malfunction:
Resistance ∞ Ω with button 2

Fault elimination:

1. Check lead 16 from multiple plug to temperature switch for open circuit.

   Eliminate open circuit.

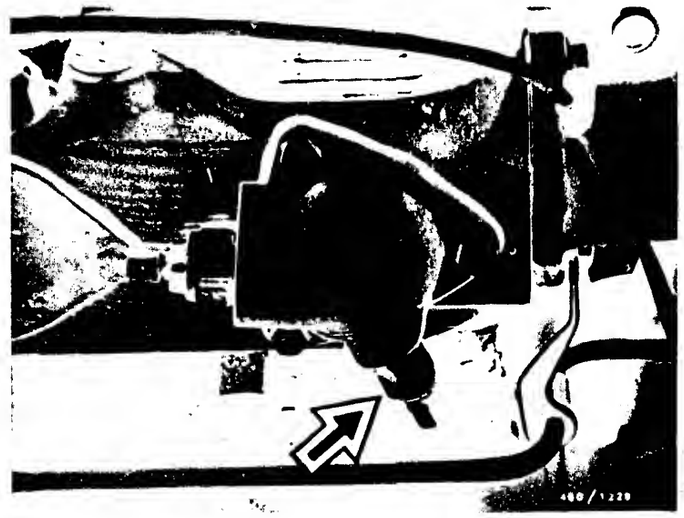
2. Temperature switch defective, replace.

Malfunction:
Resistance > 10 Ω with button 2

Fault elimination:
Temperature switch defective, replace.

yes ↓

Continue testing with next test step



Arrow = Water temperature switch

Installation position of components:

Cylinder head, on flywheel side (see illustration).

TEST STEP 6

Component/Function:
Ground connection (control unit)

Operation/Switch position:

Prog.-selec. switch "V"	↓
Prog.-selec. switch "Ω"	6
Test button	-

Plug disconnected from control unit.

Measuring equipment:

Multimeter

Measuring range: x 1 Ω
Connection: Ω sockets

Test specification: 0 ... 10 Ω

Test specification obtained?

no →

Trouble-shooting:

Malfunction:

Resistance ∞ Ω

Fault elimination:

Check leads 4 and 11 from multiple plug to ground terminal (31) for open circuit.

Eliminate open circuit.

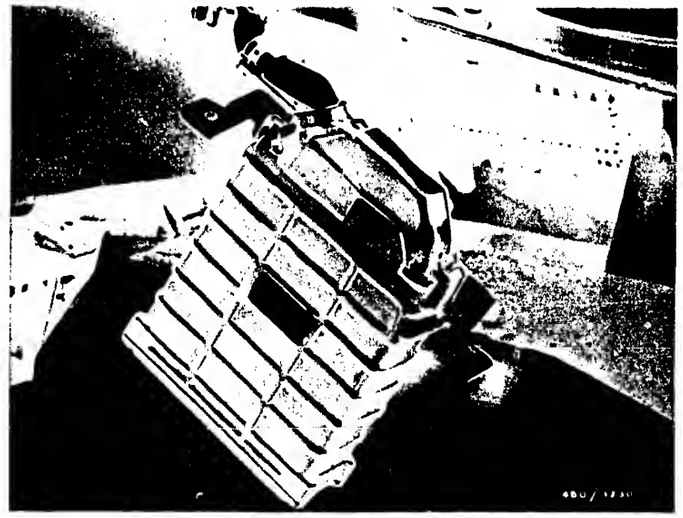
Malfunction:

Resistance > 10 Ω

Fault elimination:
Check connections of leads 4 and 11 for oxidation; eliminate oxidation.

yes ↓

Continue testing with next test step



Electronic control unit

Installation position of components:

Above glove compartment (see illustration).

TEST STEP 7

Component/Function:

Atmosphere solenoid-operated valve short circuit to ground

Operation/Switch positions:

Prog.-selec. switch "V"	↓
Prog.-selec. switch "Ω"	7
Test button	-

Plug disconnected from control unit.

Measuring equipment:

Multimeter

Measuring range: x 10 000 Ω
Connection: Ω sockets

Test specification: ∞ Ω

Test specification obtained?

no

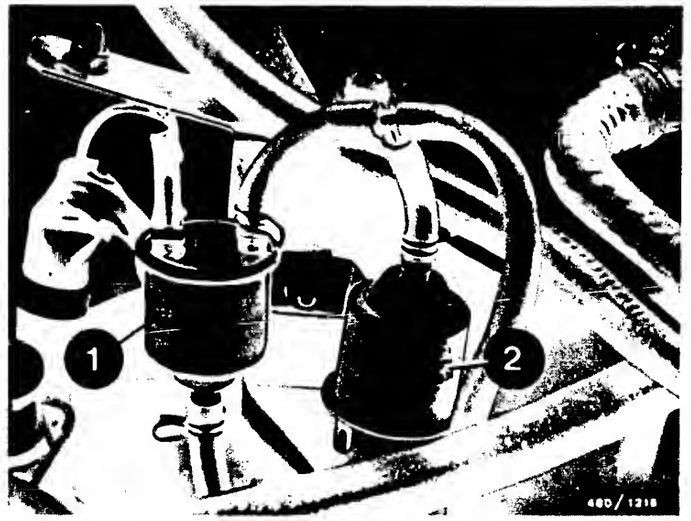
Trouble-shooting:

Malfunction:

Short circuit to ground

Fault elimination:

1. Check lead 25 from multiple plug to atmosphere solenoid-operated valve for short circuit to ground.
2. Solenoid-operated valve short circuit to ground, replace solenoid-operated valve.



1 = Vacuum solenoid-operated valve
2 = Atmosphere solenoid-operated valve

yes

Continue testing with next test step

Installation position of components:

Engine compartment on right (see illustration).

TEST STEP 8

Component/Function:

Vacuum solenoid-operated valve short circuit to ground

Operation/Switch positions:

Prog.-selec. switch "V"	↓
Prog.-selec. switch "Ω"	8
Test button	-

Plug disconnected from control unit.

Measuring equipment:

Multimeter

Measuring range: x 10 000 Ω
Connection: Ω sockets

Test specification: ∞ Ω

Test specification obtained?

no →

Trouble-shooting:

Malfunction:

Short circuit to ground

Fault elimination:

1. Check lead 13 from multiple plug to vacuum solenoid-operated valve for short circuit to ground.
2. Solenoid-operated valve short circuit to ground, replace valve.

yes ↓

Continue testing with next test step

1 = Vacuum solenoid-operated valve
2 = Atmosphere solenoid-operated valve

Installation position of components:

Engine compartment on right (see illustration, Item 1).

TEST STEP 9

Component/Function:

Atmosphere solenoid-operated valve internal resistance

Operation/Switch positions:

Prog.-selec. switch "V"	↓
Prog.-selec. switch "Ω"	16
Test button	-

Plug disconnected from control unit.

Measuring equipment:

Multimeter

Measuring range: x 1 Ω
Connection: Ω sockets

Test specification: 24...30 Ω

Test specification obtained?

no →

Trouble-shooting:

Malfunction:

Resistance ∞ Ω

Fault elimination:

1. Check lead 25 from multiple plug to atmosphere solenoid-operated valve for open circuit.

   Eliminate open circuit.

2. Solenoid-operated valve defective, replace.

Malfunction:

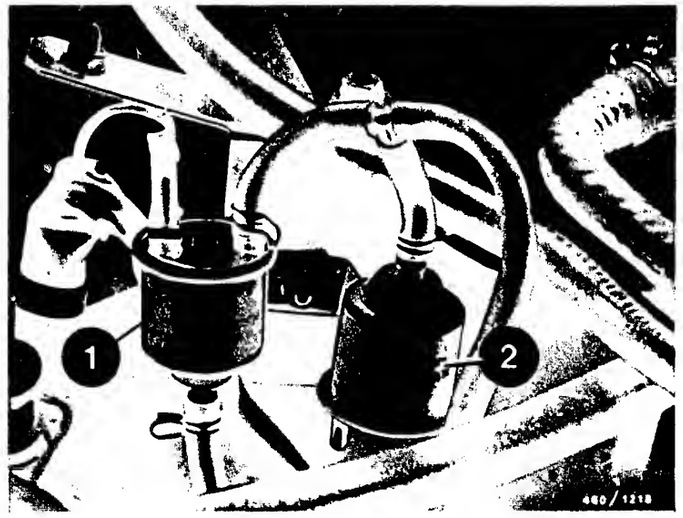
Resistance not within tolerance

Fault elimination:

Solenoid-operated valve defective, replace.

yes ↓

Continue testing with next test step



1 = Vacuum solenoid-operated valve
2 = Atmosphere solenoid-operated valve

Installation position of components:

Engine compartment on right (see illustration).

TEST STEP 10

Component/Function:

Vacuum solenoid-operated valve internal resistance

Operation/Switch positions:

Prog.-selec. switch "V"	↓
Prog.-selec. switch "Ω"	17
Test button	-

Plug disconnected from control unit.

Measuring equipment:

Multimeter

Measuring range: x 1 Ω
Connection: Ω sockets

Test specification: 24...30 Ω

Test specification obtained?

no →

Trouble-shooting:

Malfunction:

Resistance ∞ Ω

Fault elimination:

1. Check lead 13 from multiple plug to vacuum solenoid-operated valve for open circuit.
   Eliminate open circuit.

2. Solenoid-operated valve defective, replace.

Malfunction:

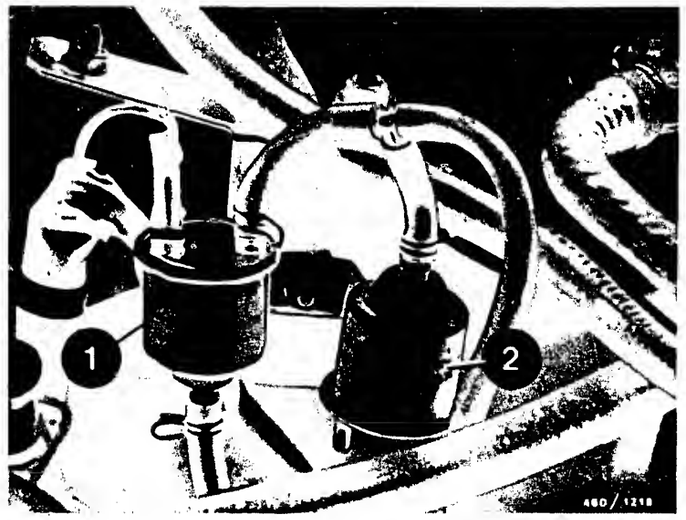
Resistance not within tolerance

Fault elimination:

Solenoid-operated valve defective, replace.

yes ↓

Continue testing with next test step



1 = Vacuum solenoid-operated valve
2 = Atmosphere solenoid-operated valve

Installation position of components:

Engine compartment on right (see illustration).

TEST STEP 11

Component/Function:

Engine-speed sensor - voltage

Operation/Switch positions:

Prog.-selec. switch "V"	1
Prog.-selec. switch "Ω"	-
Test button	-

Connect plug of adapter lead to control unit (see illustration).
Run engine at idle speed.

Measuring equipment:

Multimeter

Measuring range: 0 ... 10 V
Connection: V sockets

Test specification: 2.70...4.70 V

Test specification obtained?

no →

Trouble-shooting:

Malfunction:

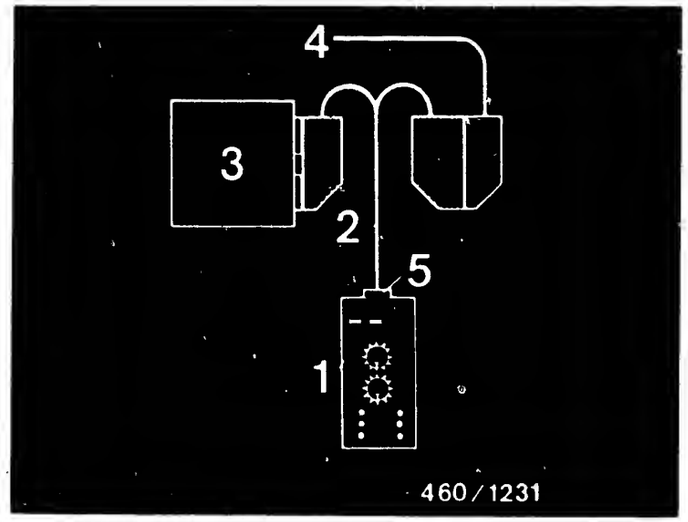
Engine-speed sensor voltage 0 V or not within tolerance

Fault elimination:

Replace engine-speed sensor.

yes ↓

Continue testing with next test step



1 = Universal test adapter
2 = System adapter lead
3 = Control unit
4 = System wiring harness
5 = Round-pin plug

Installation position of components:

Engine block on right (on turbocharger side).

TEST STEP 12

Component/Function:

Needle-movement sensor - voltage

Operation/Switch positions:

Prog.-selec. switch "V"	2
Prog.-selec. switch "Ω"	-
Test button	-

Plug connected to control unit.
Run engine at idle speed.

Measuring equipment:

Multimeter

Measuring range: 0 ... 10 V
Connection: V sockets

Test specification: 2.5...6.0 V

Test specification obtained?

no

Trouble-shooting:

Malfunction:

Needle-movement sensor voltage 0 V or not within tolerance

Fault elimination:

Needle-movement sensor defective, replace nozzle-holder assembly.

yes

Continue testing with next test step

Installation position of components:

Nozzle-holder assembly - cylinder 2.

TEST STEP 13

Component/Function:

Control unit voltage U_{QK}

Operation/Switch positions:

Prog.-selec. switch "V"	4
Prog.-selec. switch "Ω"	—
Test button	—

Plug connected to control unit.
Run engine at idle speed.

Note:
Test step possible only with vehicles with engine XD 2S - 2.3 l.

Measuring equipment:

Multimeter

Measuring range: 0 ... 3 V
Connection: V sockets

Test specification: 1.3...2.6 V

Test specification obtained?

yes

Continue testing with next test step

no

Trouble-shooting:

Malfunction:

Test specification = 0 V

Fault elimination:

Control unit defective, replace.

Malfunction:
Test specification not within tolerance

Fault elimination:
Needle-movement sensor defective, replace nozzle-holder assembly.

Installation position of components:

Control unit:
above glove compartment.
Needle-movement sensor:
nozzle-holder assembly - cylinder 2.

TEST STEP 14

Component/Function:

Control unit power supply

Operation/Switch positions:

Prog.-selec. switch "V"	6
Prog.-selec. switch "Ω"	-
Test button	-

Plug connected to control unit.
Run engine at idle speed.

Measuring equipment:

Multimeter

Measuring range: 0 ... 15 V
Connection: V sockets

Test specification: 11.5...14.5 V

Test specification obtained?

yes

Continue testing with next test step

no

Trouble-shooting:

Malfunction:
Test specification = 0 V

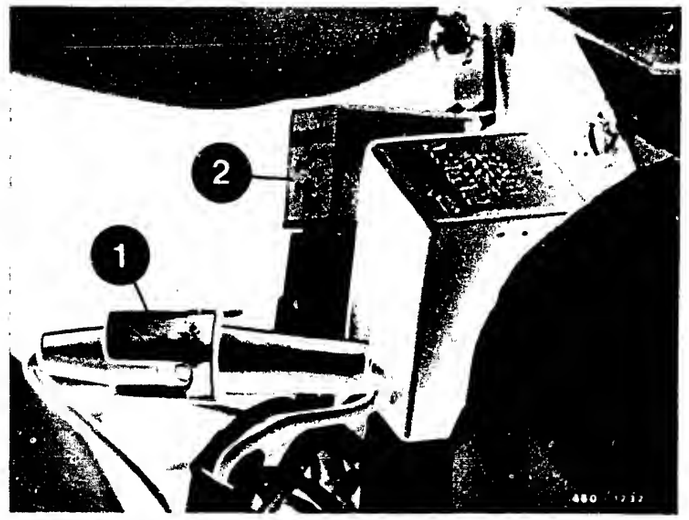
Fault elimination:

1. Fuse defective, replace.

2. Check operation and energization of power-supply relay
   + 30 at term. 30,
   + 15 at term. 86,
   - 31 at term. 85.

3. If points 1 and 2 O.K., check lead 8 from term. 87 of power-supply relay to pin 8 of multiple plug for open circuit.

   Eliminate open circuit.



1 = Fuse
2 = Power-supply relay

Installation position of components:

Fuse and power-supply relay - engine compartment on right (see illustration).

TEST STEP 15

Component/Function:

Control unit power supply

Operation/Switch positions:

Prog.-selec. switch "V"	7
Prog.-selec. switch "Ω"	-
Test button	-

Plug connected to control unit.
Run engine at idle speed.

Measuring equipment:

Multimeter

Measuring range: 0 ... 15 V
Connection: V sockets

Test specification: 11.5...14.5 V

Test specification obtained?

no

Trouble-shooting:

Malfunction:

Test specification = 0 V

Fault elimination:

Check lead 12 from multiple plug to power-supply relay terminal 87 for open circuit.

Eliminate open circuit.

yes

Continue testing with next test step

Installation position of components:

Control unit:
above glove compartment.

TEST STEP 16

Component/Function:

Control unit power supply

Operation/Switch positions:

Prog.-selec. switch "V"	8
Prog.-selec. switch "Ω"	-
Test button	-

Plug connected to control unit.
Run engine at idle speed.

Measuring equipment:

Multimeter

Measuring range: 0 ... 15 V
Connection: V sockets

Test specification: 11.5...14.5 V

Test specification obtained?

no

Trouble-shooting:

Malfunction:

Test specification = 0 V

Fault elimination:

Check lead 24 from multiple plug to connection point/power-supply relay term. 87 for open circuit.

Eliminate open circuit.

yes

Continue testing with next test step

Installation position of components:

Control unit:
above glove compartment.

TEST STEP 17

Component/Function:

Air-flow sensor power supply

Operation/Switch positions:

Prog.-selec. switch "V"	10
Prog.-selec. switch "Ω"	-
Test button	-

Plug connected to control unit.
Run engine at idle speed.

Measuring equipment:

Multimeter

Measuring range: 0 ... 3 V
Connection: V sockets

Test specification: 1.3...2.0 V

Test specification obtained?

no →

Trouble-shooting:

Malfunction:

Test specification = 0 V or not within tolerance

Fault elimination:

Control unit defective, replace.

yes ↓

Continue testing with next test step

Installation position of components:

Control unit:
above glove compartment.

TEST STEP 18

Component/Function:

Air-flow sensor - voltage

Operation/Switch positions:

Prog.-selec. switch "V"	11
Prog.-selec. switch "Ω"	-
Test button	-

Plug connected to control unit.
Run engine at idle speed.

Measuring equipment:

Multimeter

Measuring range: 0 ... 1 V
Connection: V sockets

Test specification: 307...411 mV

Test specification obtained?

no →

Trouble-shooting:

Malfunction:
Air-flow sensor voltage = 0 V

Fault elimination:

1. Check lead 22 from multiple plug to term. 7 on air-flow sensor for open circuit. Eliminate open circuit.

2. Air-flow sensor defective, replace.

Malfunction:
Air-flow sensor voltage not within tolerance

Fault elimination:

Air-flow sensor defective, replace.

yes ↓

Continue testing with next test step

1 = Air-flow sensor

Installation position of components:

Engine compartment on right, underneath air filter.

TEST STEP 18.1

Component/Function:

Air-flow sensor - voltage

Operation/Switch positions:

Prog.-selec. switch "V"	11
Prog.-selec. switch "Ω"	–
Test button	5/6

Plug connected to control unit.
Run engine at idle speed.

Measuring equipment:

Multimeter

Measuring range: 0 ... 1 V
Connection: V sockets

Test specification: 270...680 mV

Does measuring instrument show a voltage change when buttons 5 and 6 are pressed?

no →

yes ↓

Continue testing with next test step

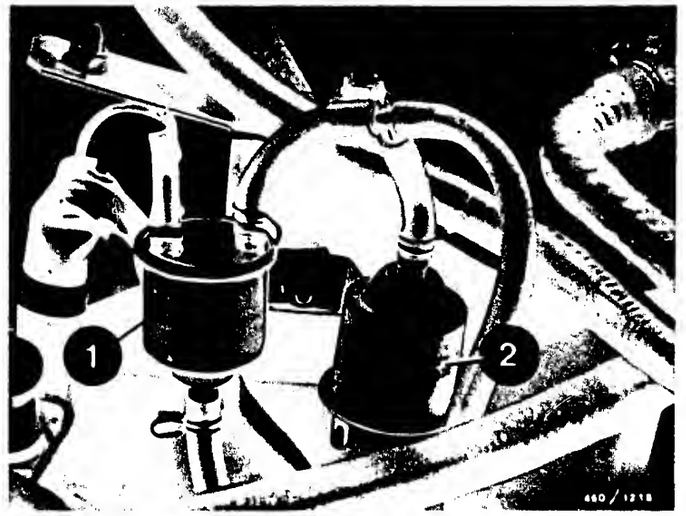
Trouble-shooting:

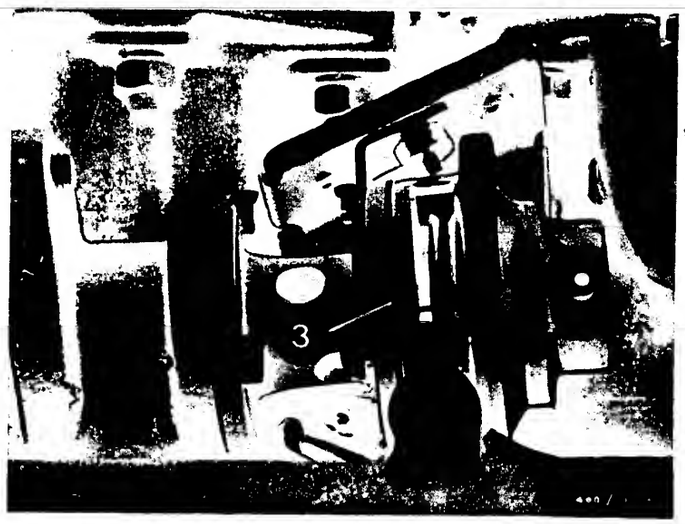
Malfunction:

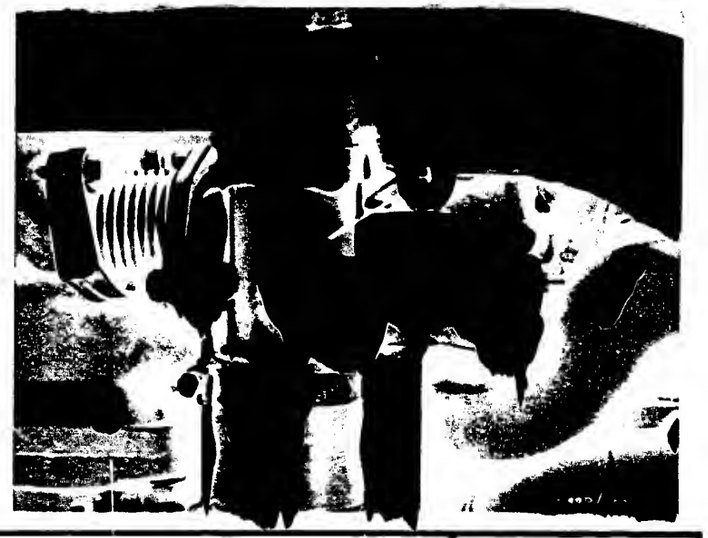
No voltage change.

Fault elimination:

1. Check operation of solenoid-operated valves for vacuum (1) and atmosphere (2) (see top illustration).
2. Check operation of EGR valve (3, see center illustration) and throttle-valve assembly (4, see bottom illustration).
3. Sensor flap of air-flow sensor stiff; if necessary, replace air-flow sensor (not shown).







Installation position of components:

All components are in the engine compartment/on the engine block on the right.

TEST STEP 19

Component/Function:

Operation of EGR valve

Operation/Switch positions:

Prog.-selec. switch "V"	12
Prog.-selec. switch "Ω"	–
Test button	6

Plug connected to control unit.
Run engine at idle speed.

Measuring equipment:

None

Operation: EGR valve closed

EGR valve closes?

no

Trouble-shooting:

Malfunction:

EGR valve open.

Fault elimination:

1. Check hose connections for leaks.

2. EGR valve defective, replace.

yes

Continue testing with next test step

Installation position of components:

Engine block on right.

TEST STEP 20

Component/Function:
Operation of EGR valve

Operation/Switch positions:

Prog.-selec. switch "V"	13
Prog.-selec. switch "Ω"	–
Test button	5

Plug connected to control unit.
Run engine at idle speed.

Measuring equipment:
None

Operation: EGR valve open

EGR valve opens?

no →

Trouble-shooting:

Malfunction:

EGR valve closed.

Fault elimination:

1. Check hose lines for leaks.
2. EGR valve defective, replace.

yes ↓

Testing with system adapter lead completed.

Switch off ignition.
Remove adapter lead.
Connect multiple plug of vehicle wiring harness to control unit.

The following test step is only possible for vehicles with engine XD 3T - 2.5 l.

Installation position of components:

Engine block on right.

TEST STEP 21

Component/Function:

Operation of altitude switch (only on vehicles with engine XD 3T - 2.5 l).

Disconnect plug from altitude switch (see illustration, arrow).

Measuring equipment:

Multimeter

Measuring range: x 10 Ω or
x 10 000 Ω

Connection: Altitude switch term. 1 and term. 3 (see bottom diagram).

Test specifications:

Switch closed ≤ 880 mbar
= 475...525 Ω
Switch open ≥ 930 mbar
= ∞ Ω

Test specification obtained?

no →

Trouble-shooting:

Malfunction:

Test specifications not obtained at given altitude.

Fault elimination:

Altitude switch defective, replace switch.

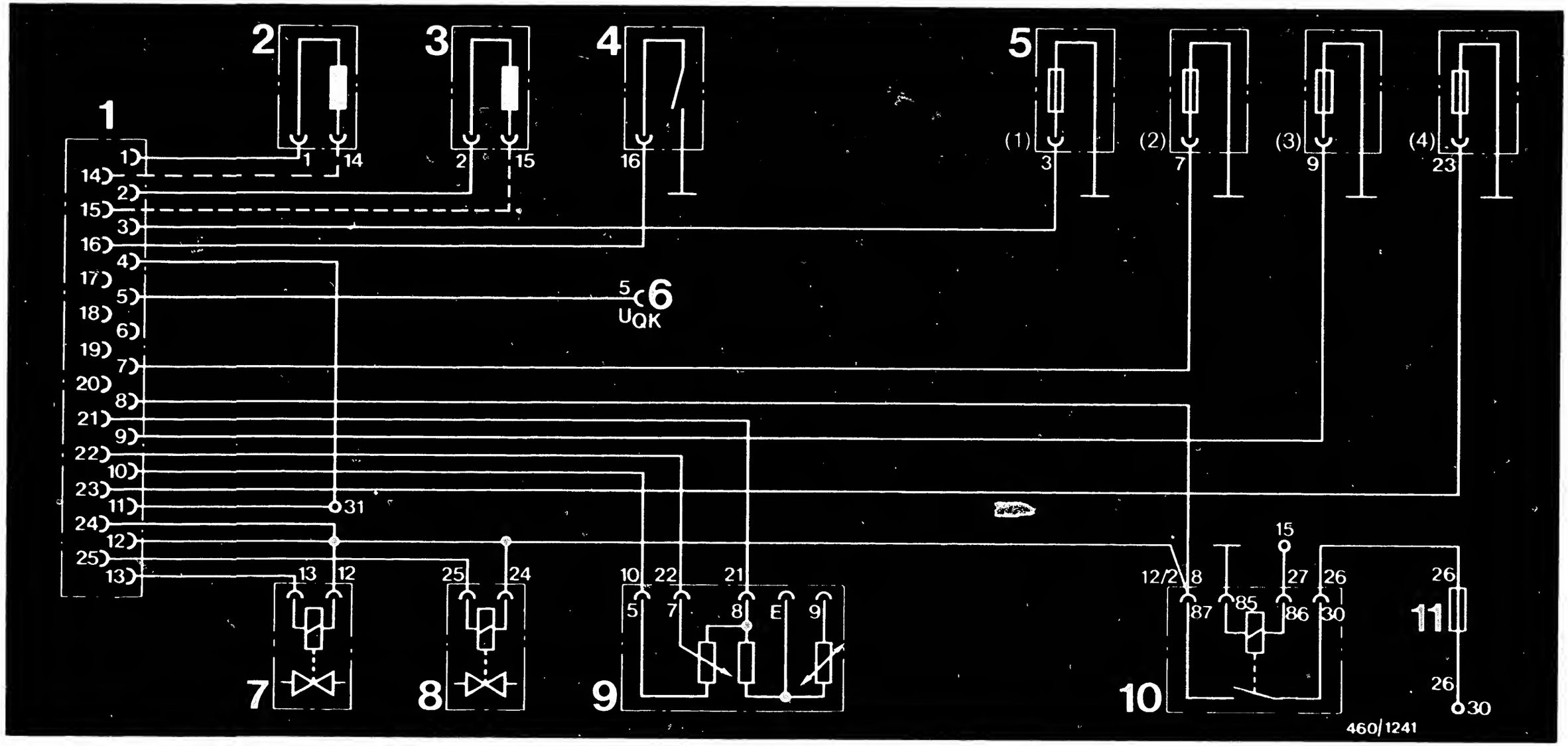
yes ↓

Testing of duration-of-injection exhaust-gas recirculation completed.

Arrow = Plug on altitude switch

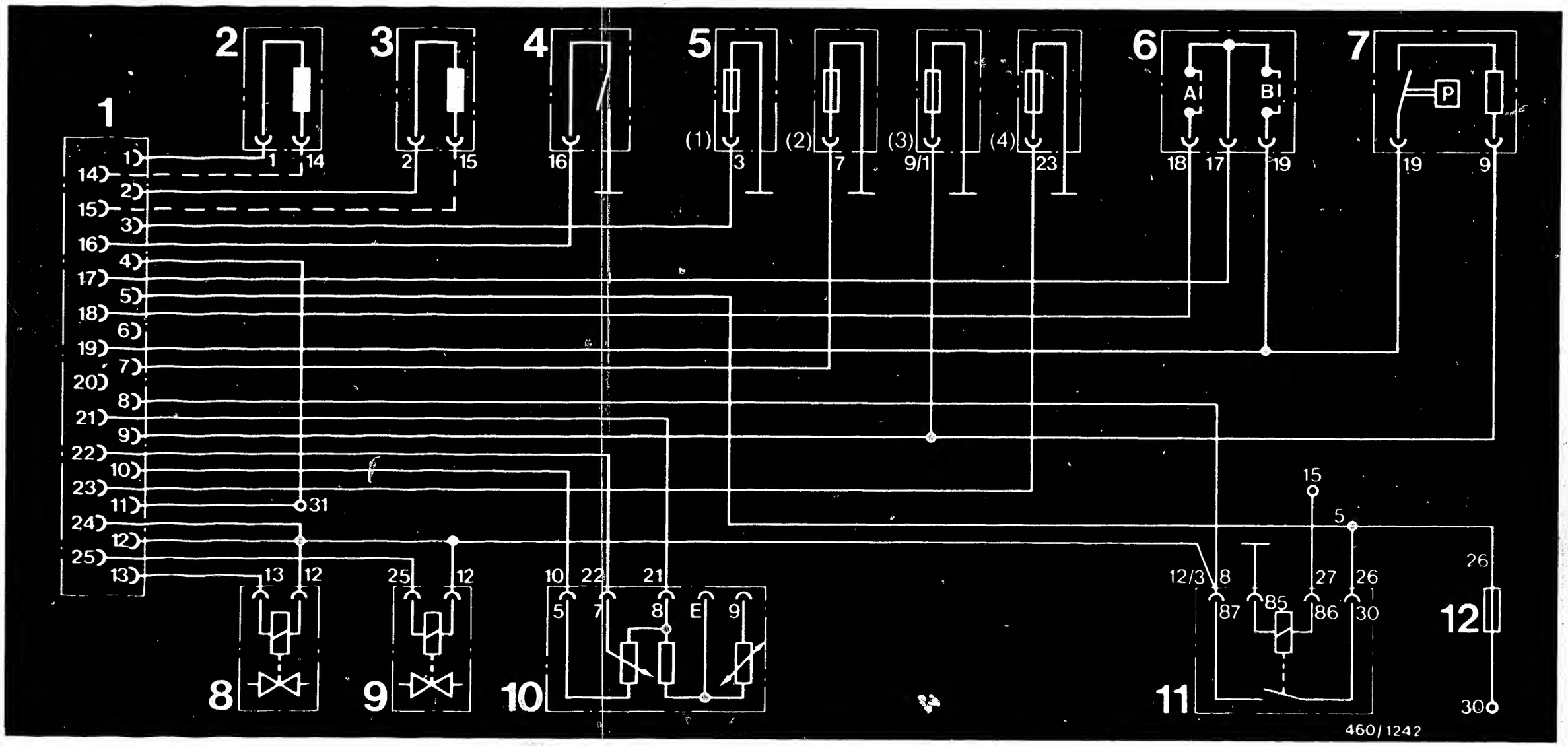
Installation position of components:

Engine compartment on right on air filter (see top illustration).



Electrical terminal diagram for closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal - engine XD 2S - 2.3 l

1 = Control-unit plug
2 = Engine-speed sensor
3 = Needle-movement sensor
4 = Temperature sensor
5 = Fuses (running-time electronics)
6 = Measuring output U_{QK} (for engine XD 2S - 2.3 l)
7 = Vacuum solenoid-operated valve
8 = Atmosphere solenoid-operated valve
9 = Air-flow sensor
10 = Power-supply relay
11 = Fuse



Electrical terminal diagram for closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal - engine XD 3T - 2.5 l

1 = Control-unit plug
2 = Engine-speed sensor
3 = Needle-movement sensor
4 = Temperature sensor
5 = Fuses (running-time electronics)
6 = Correction plug
7 = Altitude correction
8 = Vacuum solenoid-operated valve
9 = Atmosphere solenoid-operated valve
10 = Air-flow sensor
11 = Relay
12 = Fuse

28. Replace fuse box of running-time electronics

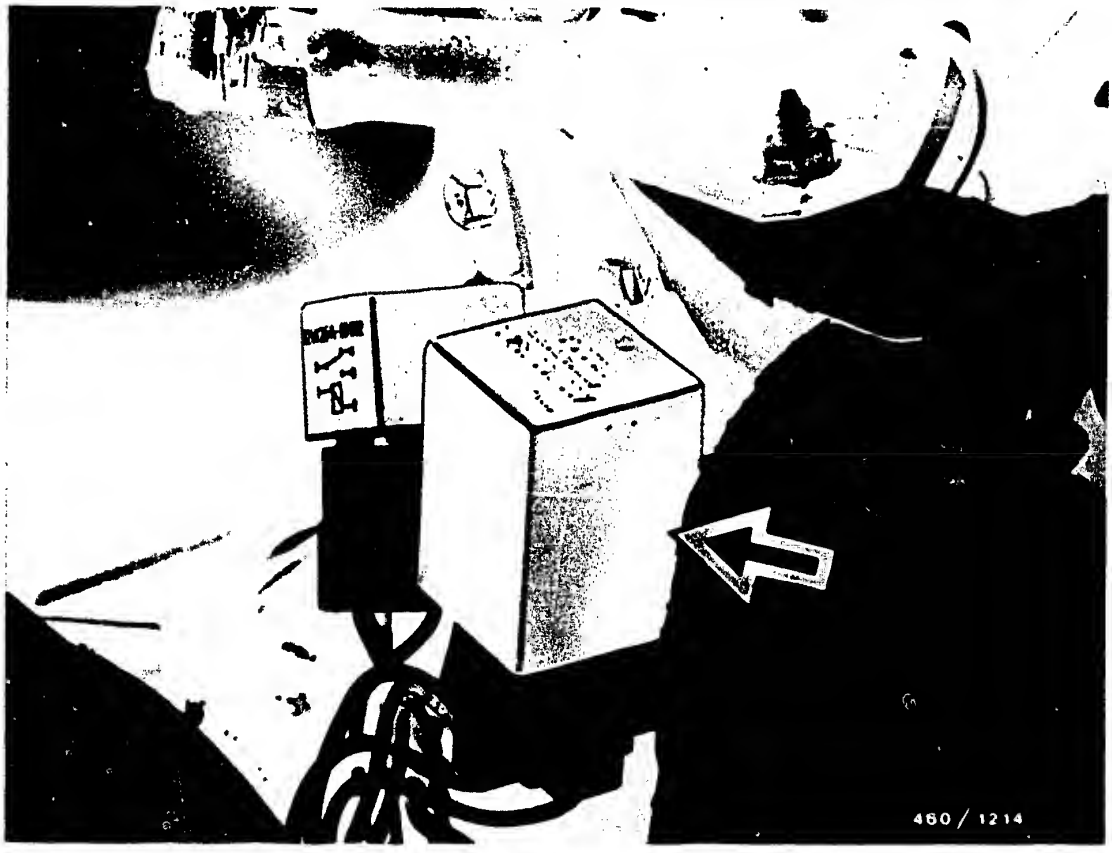
The control unit of the closed-loop-controlled exhaust-gas recirculation with duration-of-injection signal is additionally provided with a running-time electronic unit which has the task of compensating for the absence of carbon-fouling on new nozzles (less exhaust is recirculated when new).

Depending on the operating time (running time) of a nozzle, there is a change in the degree of carbon-fouling and, accordingly, in the flow rate. Consequently, the duration of injection becomes longer as the carbon-fouling increases; this in turn influences the exhaust emissions.

To compensate for the absence of carbon-fouling, the injection cycles are detected by a needle-movement sensor (integrated in the nozzle holder) and are added up in a counting memory (in the control unit). When the max. counter status is reached, a fuse in the running-time electronics is blown by the control unit. This changes the exhaust-gas recirculation rate.

The duration of compensation is dependent on the speed and mileage of the vehicle.

When all fuses of the running-time electronics have been blown one after the other, there is no longer any correction.



The fuses of the running-time electronics are grouped together in a fuse box (see illustration, arrow) which is situated next to the coolant expansion tank.

Notes on installing new nozzles

- Vehicle with engine XD 2S - 2.3 l:
  Replace fuse box.

- Vehicle with engine XD 3T - 2.5 l:
  Replace fuse box and re-activate counting memory (in control unit) by briefly disconnecting the positive pole of the battery.

29. Checking the preheating system

29.1 Tester required

VA-Tester	e.g., ETT 011.00	0 684 101 100

29.2 Workshop instructions

29.2.1 We recommend replacing the R sheathed-element glow plugs every 45000 km.

Note:
Incorrect setting of the start of fuel delivery can shorten considerably the service life of the sheathed-element glow plugs.

29.2.2 On each repeated start, in order to attain a new preheating, first bring the glow-plug and starting switch into the setting St and then into the setting M.
That reactivates the safety shutoff built into the glow duration unit.

29.2.3 If there is a voltage greater than 16 V present at Term. 3 of the glow duration unit (e.g., during quick-charging), the glow duration unit does not switch on. If the increased voltage occurs during the preheating, the glow duration unit switches off immediately. (Overvoltage protection for the R sheathed-element glow plugs).

29.2.4 In case of short-circuit (short-circuit current from approx. 240 A) in power circuit Term. 1 and at Term. 5 of the glow duration unit, including the R sheathed-element glow plug, the glow duration unit switches off.

29.3 Preheating time

How long the preheating system is switched on depends upon the ambient temperature.

Note:

In order to avoid destruction of the glow duration unit, the bulb installed in the starting indicator light must be 12 V, max. 2 Watt.

Prerequisites for testing:

Battery fully charged.

Compression O.K. If need be, check compression loss.

Fuel supply system and/or fuel-injection system O.K.

Starting motor turns, engine does not start or starts only with difficulty

yes

Check voltage supply to the R sheathed-element glow plugs

Connect a voltmeter to the R sheathed-element glow plug and ground. Bring the glow-plug starting switch into setting St and then into setting M.
For at least 11 seconds (dependent on temperature) a minimum voltage of 10 V must be indicated.
After this time, the system switches off automatically.

N.B.:

If the measurement should be repeated, first bring the glow-plug starting switch into setting St and then into setting M.

Is the minimum voltage present?

no →

1. Voltage less than 10 V. Check the power circuit (battery +) and Term. 1 and Term. 5 of the glow duration unit for a voltage drop. Eliminate any voltage drop.
2. If there is no voltage present, then check the lead from the R sheathed-element glow plug to the glow duration unit Term. 5 for a break. Eliminate any break. If there is no break, then continue at Coordinates H5/H6. Not necessary to continue here.

yes

Check the start indicator light

Bring the glow-plug starting switch into setting St and then into setting M.
The start indicator light must come on.

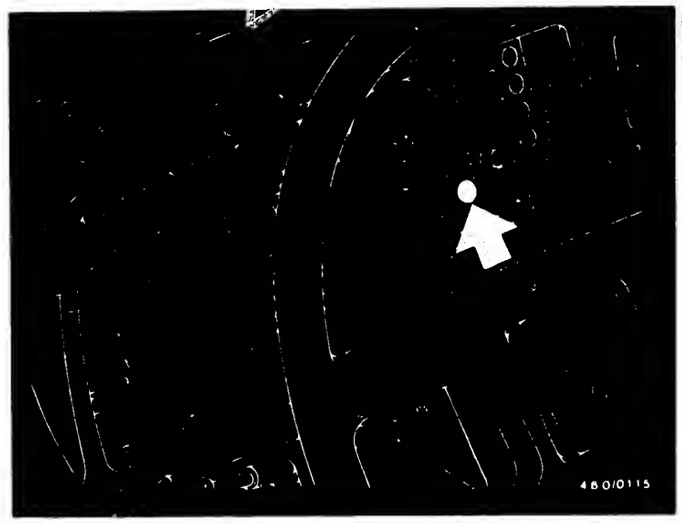
Does the start indicator light light?

no →

1. Check the lead from the glow-plug starting switch Term. 15 to the glow duration unit Term. 3 for a break. Eliminate any break.
2. Check the lead from the glow duration unit Term. 6 including the start indicator light and its ground connection, for a break. Eliminate any break.
3. Check the ground lead Term. 2 from the glow duration unit for a break. Eliminate any break.

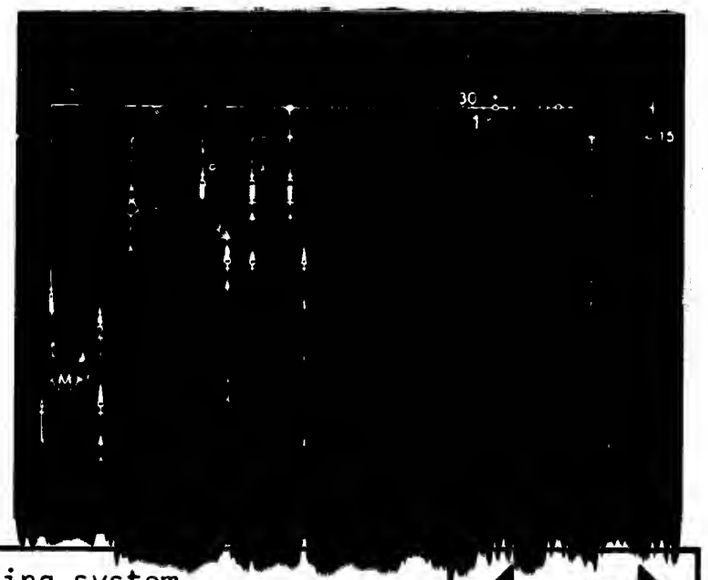
yes

Continue on H1/H2



Installation position, start indicator light (arrow)

1 = Battery
2 = Preheater indicator light (12 V, 2 W)
3 = Glow duration unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Sheathed-element glow plugs



Checking preheating system (continued)

yes

Checking preheating duration

Bring the glow-plug and starting switch into setting St and then into setting M. The duration of preheating (start indicator light comes on) must be as follows at the ambient temperatures shown:

0°C - 7 ... 11 seconds
+ 10°C - 6 ... 10 seconds
+ 20°C - 4 ... 8 seconds
+ 30°C - 3 ... 6 seconds
+ 40°C - 1 ... 5 seconds.

Is the preheating duration (seconds) O.K.?

no → Take out and replace the glow duration unit.

yes

Checking the safety circuit

Connect a voltmeter to the R sheathed-element glow plug and ground. Bring the glow-plug starting switch into setting St and then into setting M. The voltmeter must show a voltage as indicated below for the ambient temperatures shown:

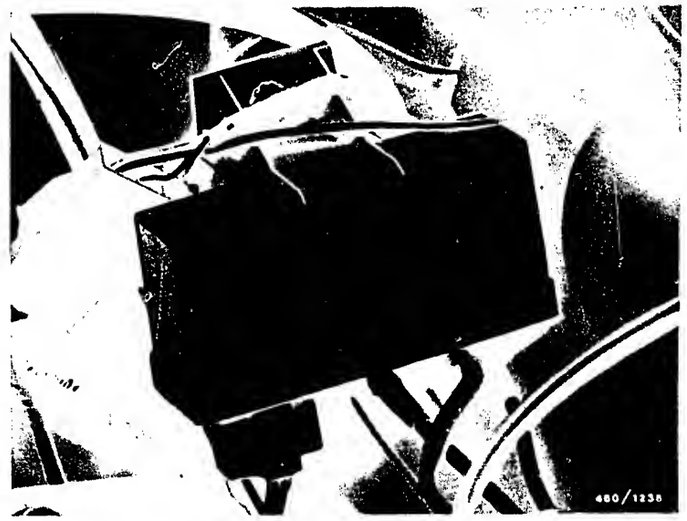
0°C for 16 ... 20 seconds
+ 10°C for 15 ... 19 seconds
+ 20°C for 14 ... 18 seconds
+ 30°C for 13 ... 17 seconds
+ 40°C for 12 ... 16 seconds.

After the prescribed time has passed, the voltmeter must read 0 V.
Does the voltmeter return to 0 V after the prescribed time?

no → Take out and replace the glow duration unit.

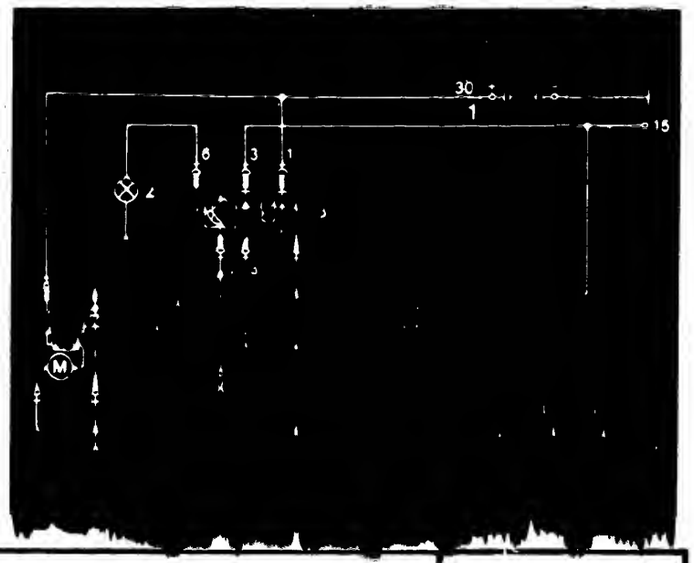
yes

Continued on H3/H4



Installation position, glow duration unit.

1 = Battery
2 = Preheater indicator light (12 V, 2 W)
3 = Glow duration unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Sheathed-element glow plugs



Checking the preheating system (continued)

yes

Check preheating when starting motor is turned on

Connect a voltmeter to the R sheathed-element glow plug and ground. Bring the glow-plug starting switch into setting D. The voltmeter must indicate a voltage of 6 ... 10 V.

Is there voltage present?

no

1. Check the lead from the glow-plug and starting switch Term. 50 to the glow duration unit Term. 4 for a break. Eliminate any break.
2. If point 1 is O.K., then take out and replace the glow duration unit.

yes

Checking the R sheathed-element glow plugs

Check the R sheathed-element glow plugs individually for continuity, using an ohmmeter.

Does the R sheathed-element glow plug have continuity?

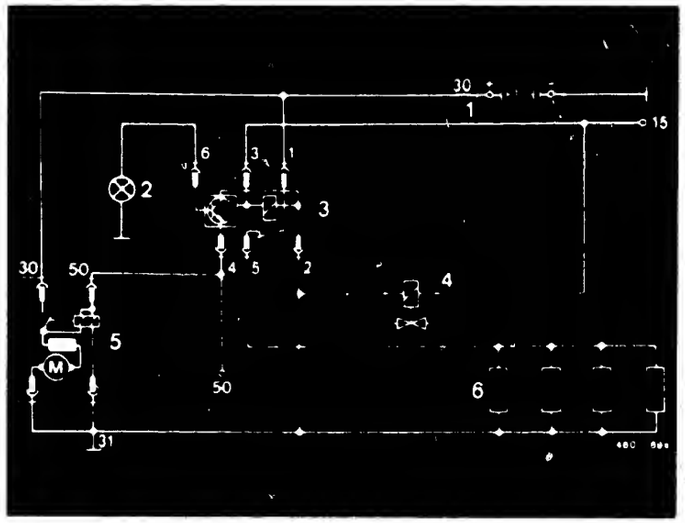
no

Take out and replace the R sheathed-element glow plug

yes

Preheating system O.K.

Testing starting from H 5 not necessary.



1 = Battery
2 = Preheater indicator light (12 V, 2 W)
3 = Glow duration unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Sheathed-element glow plugs

Checking preheating system (continued from G23/G24)

Check voltage at the glow duration unit Term. 3.

Connect a voltmeter to the glow duration unit Term. 3 and ground. Bring the glow-plug and starting switch into setting St and then into setting M.
Voltmeter must indicate battery voltage.
Is there battery voltage present?

no → Check the lead from the glow duration unit Term. 3 to the glow-plug and starting swi for a break.

Eliminate any break.

yes ↓

Check the ground lead Term. 2 from the glow duration unit. Connect a voltmeter to the glow duration unit Term. 2 and battery +.
The voltmeter must indicate battery voltage.
Is there battery voltage present?

no → Check the ground lead Term. 2 from the glow duration unit for a break.

Eliminate any break.

yes ↓

Check the voltage at the glow duration unit Term. 1.

Connect a voltmeter to the glow duration unit Term. 1 and ground. The volt-meter must indicate battery voltage.
Is there battery voltage present?

no → Check the lead from the glow duration unit Term. 1 to battery + for a break.

Eliminate any break.

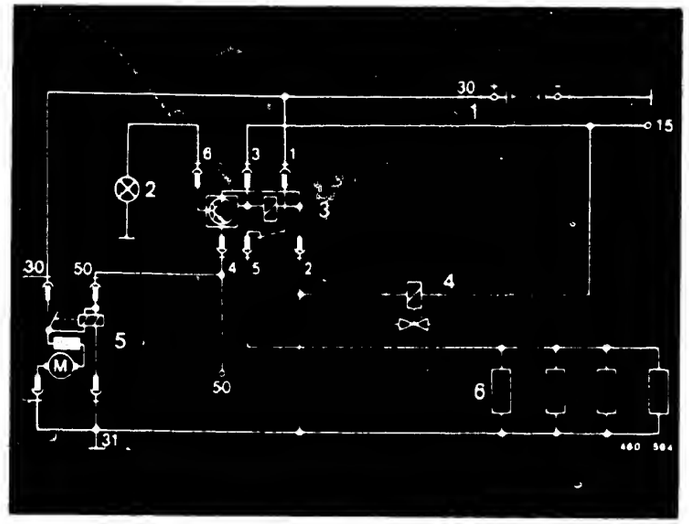
yes ↓

Is there voltage present now at the R sheathed-element glow plug?

no → Take out and replace the glow duration unit.

yes ↓

Continued on H7/H8



1 = Battery
2 = Preheater indicator light (12 V, 2 W)
3 = Glow duration unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Sheathed-element glow plugs

Checking preheating system (continued)

yes

Checking the start indicator light

Bring the glow-plug and starting switch into setting St and then into setting M.
The start indicator light must come on.
Does the start indicator light light?

no

1. Check the lead from the glow-plug and starting switch Term. 15 to the glow duration unit Term. 3 for a break. Eliminate any break.
2. Check the lead from the glow duration unit Term. 6, including the start indicator light and its ground connections, for a break. Eliminate any break.
3. Check the ground lead Term. 2 from the glow duration unit for a break. Eliminate any break.

yes

Checking the preheating duration

Bring the glow-plug and starting switch into position St and then into position M.
The duration of preheating (start indicator light comes on) must be as shown below at the ambient temperatures indicated :

0°C – 7 ... 11 seconds
+ 10°C – 6 ... 10 seconds
+ 20°C – 4 ... 8 seconds
+ 30°C – 3 ... 6 seconds
+ 40°C – 1 ... 5 seconds.

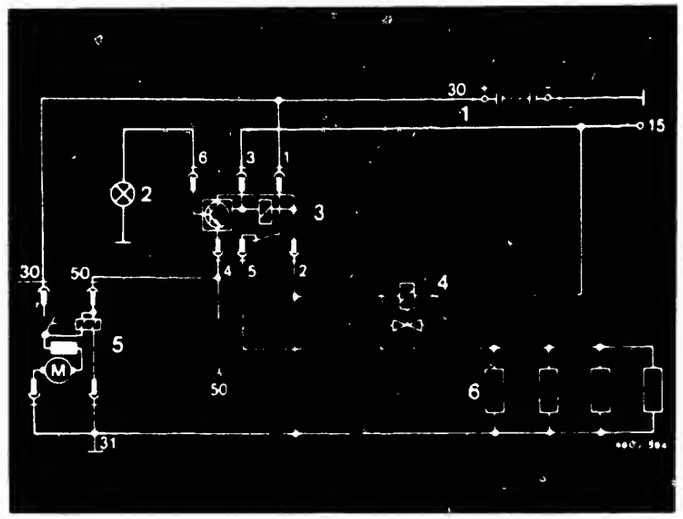
Is the preheating duration (seconds) O.K.?

no

Take out and replace the glow duration unit.

yes

Continued on H9/H10



1 = Battery
2 = Preheater indicator light (12 V, 2 W)
3 = Glow duration unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Sheathed-element glow plugs

Checking the preheating system (continued)

yes

Checking the safety circuit
Connect a voltmeter to the R sheathed-element glow plug and ground. Bring the glow-plug and starting switch into setting St and then into setting M. The voltmeter must indicate a voltage for the time shown at the ambient temperatures below:

0°C for 16 ... 20 seconds
+ 10°C for 15 ... 19 seconds
+ 20°C for 14 ... 18 seconds
+ 30°C for 13 ... 17 seconds
+ 40°C for 12 ... 16 seconds.

After the prescribed time has passed, the voltmeter must read 0 V.
Does the voltmeter return to 0 V after the prescribed time?

no → Take out and replace the glow duration unit.

yes

Check the preheating when the starting motor is turned on. Connect a voltmeter to the R sheathed-element glow plug and ground. Bring the glow-plug and starting switch into setting D. The voltmeter must indicate a voltage of 6...10V. Is there voltage present?

no →
1. Check the lead from the glow-plug and starting switch Term. 50 to the glow duration unit Term. 4 for a break. Eliminate any break.
2. If point 1 is O.K., then take out and replace the glow duration unit.

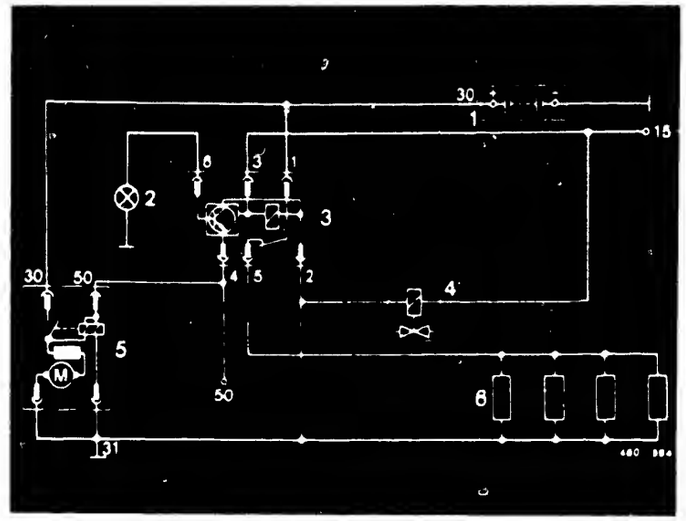
yes

Check the R sheathed-element glow plugs. Check the R sheathed-element glow plugs individually for continuity using an ohmmeter. Does the R sheathed-element glow plug have continuity?

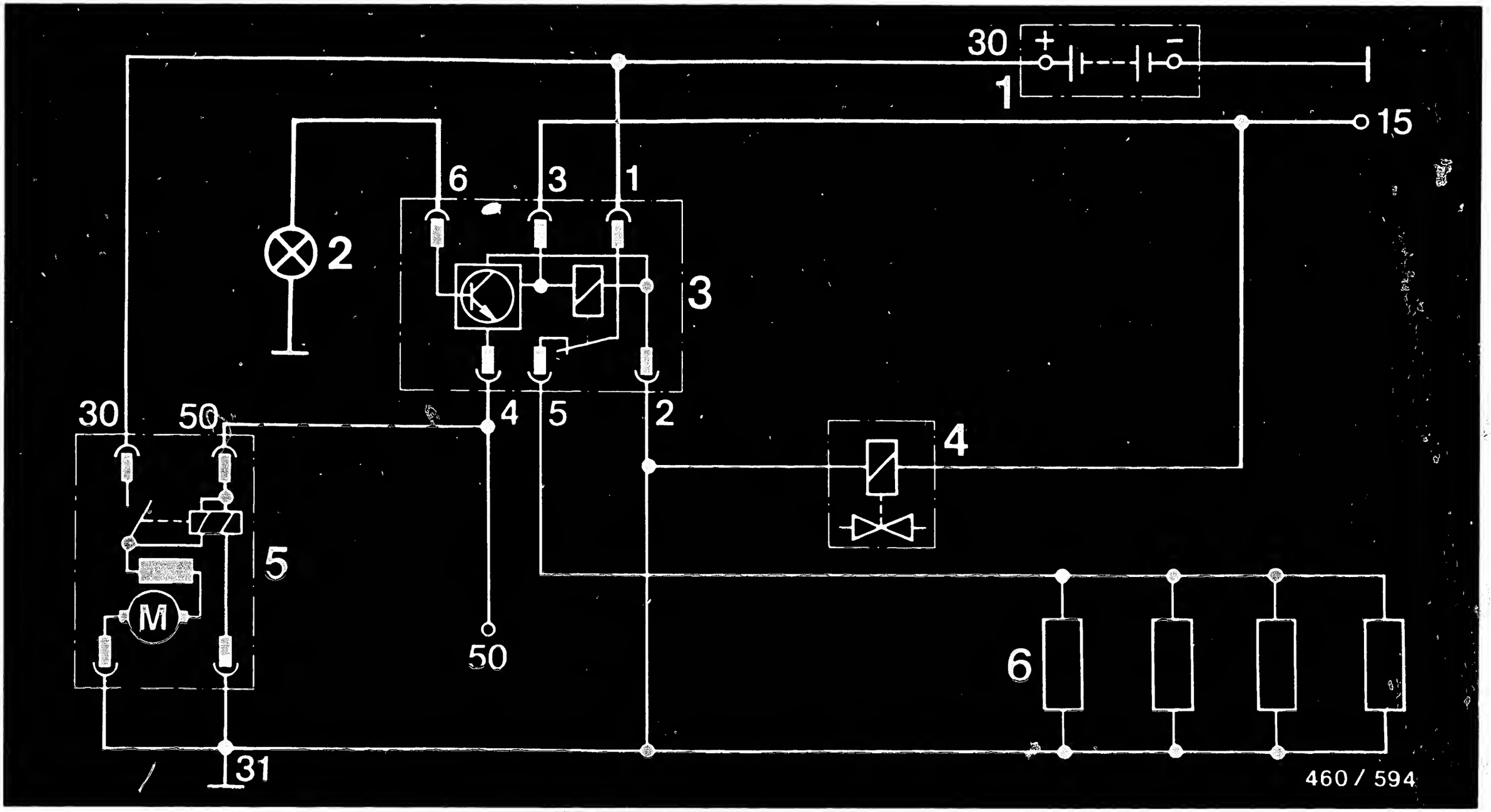
no → Take out and replace the R sheathed-element glow plug.

yes

Preheating system O.K.

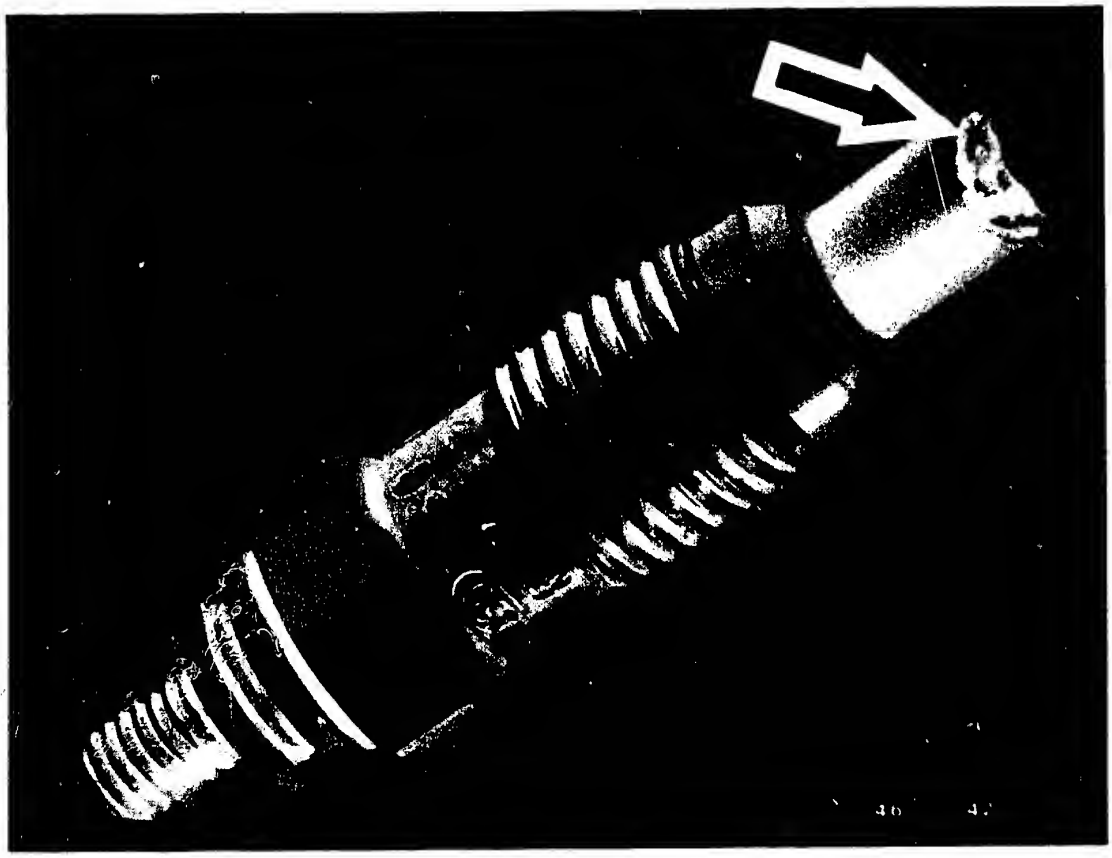


1 = Battery
2 = Preheater indicator light (12 V, 2 W)
3 = Glow duration unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Sheathed-element glow plugs



1 = Battery
2 = Preheating indicator light (12 V, max. 2 W)
3 = Glow duration unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Sheathed-element glow plugs

Connection diagram for preheating system



Note:

Glow plugs with burnt glow elements

Glow plugs with burnt glow elements are frequently secondary damage due to nozzle problems.

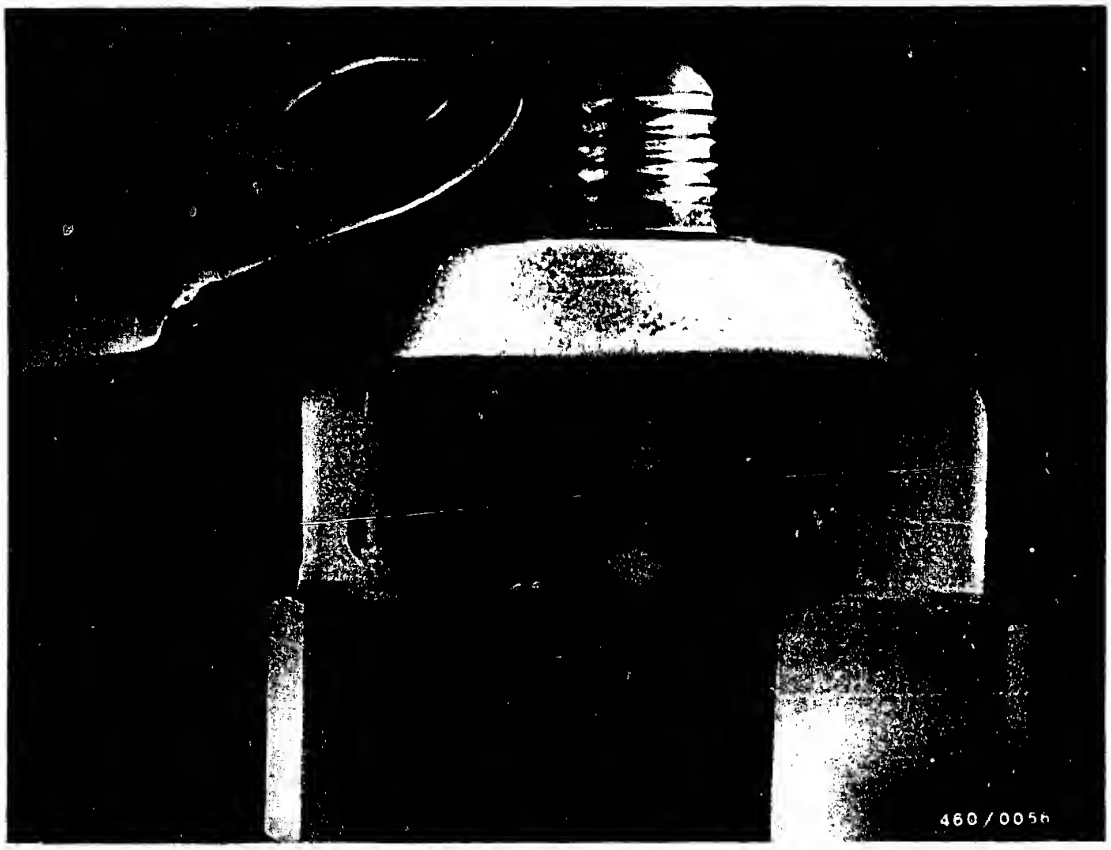
If, when a complaint has been made, glow plugs of this type are found (arrow), it is not sufficient merely to replace them. The fuel-injection nozzles must also be tested for spray pattern, chatter, pressure, and leaks.

30. Checking the timing device

In the case of the distributor-type fuel-injection pumps VE..F.., the timing device is integrated into the fuel-injection pump.

The fuel-injection pump must be taken out in order to test the timing device.

The test is done on the fuel-injection pump test stand.



31. Measuring engine compression and compression loss

31.1 Measuring engine compression

Put a new sheet of graph paper into the compression pressure recorder. Fasten a high pressure hose to the recorder. Shut off the engine.

In order to prevent fuel from being injected, remove the connecting lead at the shutoff solenoid for the distributor-type fuel-injection pump (Figure).

Unscrew the sheathed-element glow plugs and use a suitable connecting nipple for the compression pressure tester.

Turn the engine several times using the starting motor, so as to remove loose remnants from the compression chamber.

Screw in the connecting nipple.

Mount the high pressure hose for the compression pressure tester on the connecting nipple.

In the job step below, watch particularly the first compression stroke.

Activate the starting motor until no further increase in pressure can be detected on the compression pressure recorder.

Bleed the compression pressure recorder by pressing on the bleeder valve.

The needle returns to its initial position when this is done.

Move the graph paper to the next position.

Fasten the connecting nipple to the cylinders that follow and repeat the measurement.

Compression pressure:	25 ... 30 bar
Allowable deviation between cylinders:	max. 5 bar

31.1.1 Evaluation of the graph

1. Normal pressure rise

If the piston rings and valves are proper, the first compression stroke shows the greatest increase in pressure. During the subsequent compression strokes, the compression pressure builds up to the maximum pressure.

2. Step-by-step increase in pressure

If the compression pressure increases only step-by-step per piston stroke from the start on, that indicates burnt valve seats or inadequate valve guidance.

3. Insufficient max. pressure

If the max. compression pressure attained is too low at all cylinders, that indicates defective pistons, piston rings, or valves. Inadequate compression pressure at two adjacent cylinders indicates a leak in the cylinder head gasket.

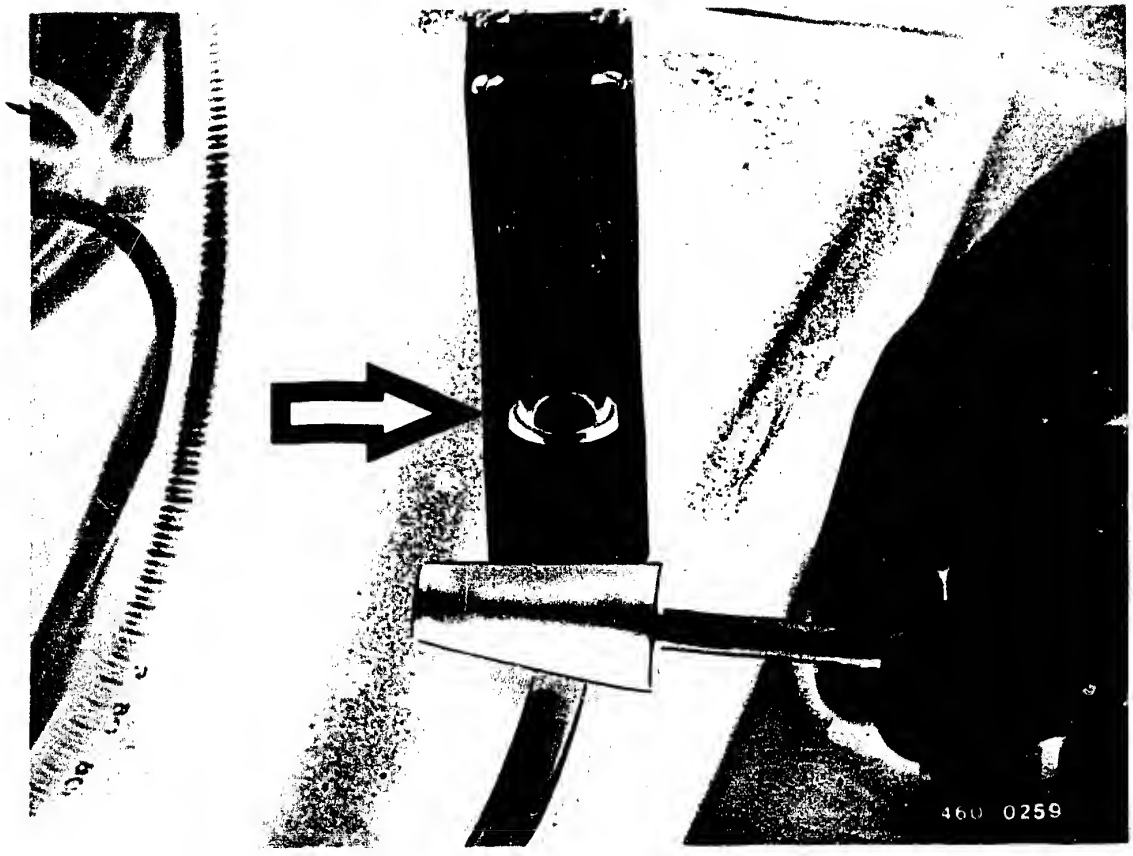
4. Variations in compression pressure

If one cylinder shows a compression pressure clearly lower, proceed as follows:
Through the opening in the sheathed-element glow plug or the nozzle holder, put in 2 ... 3 cm^3 of motor oil and run the starting motor briefly.

Repeat the tests and compare the graph sheets. If the compression pressure is clearly higher in the second test, there is wear on the piston rings or the cylinder. If the result does not change, damaged valves are the cause.

5. Uniform compression pressure

A uniform compression pressure is of very great importance for smooth running of the engine. For that reason, it is not sufficient merely to strive for as high a compression pressure as possible.



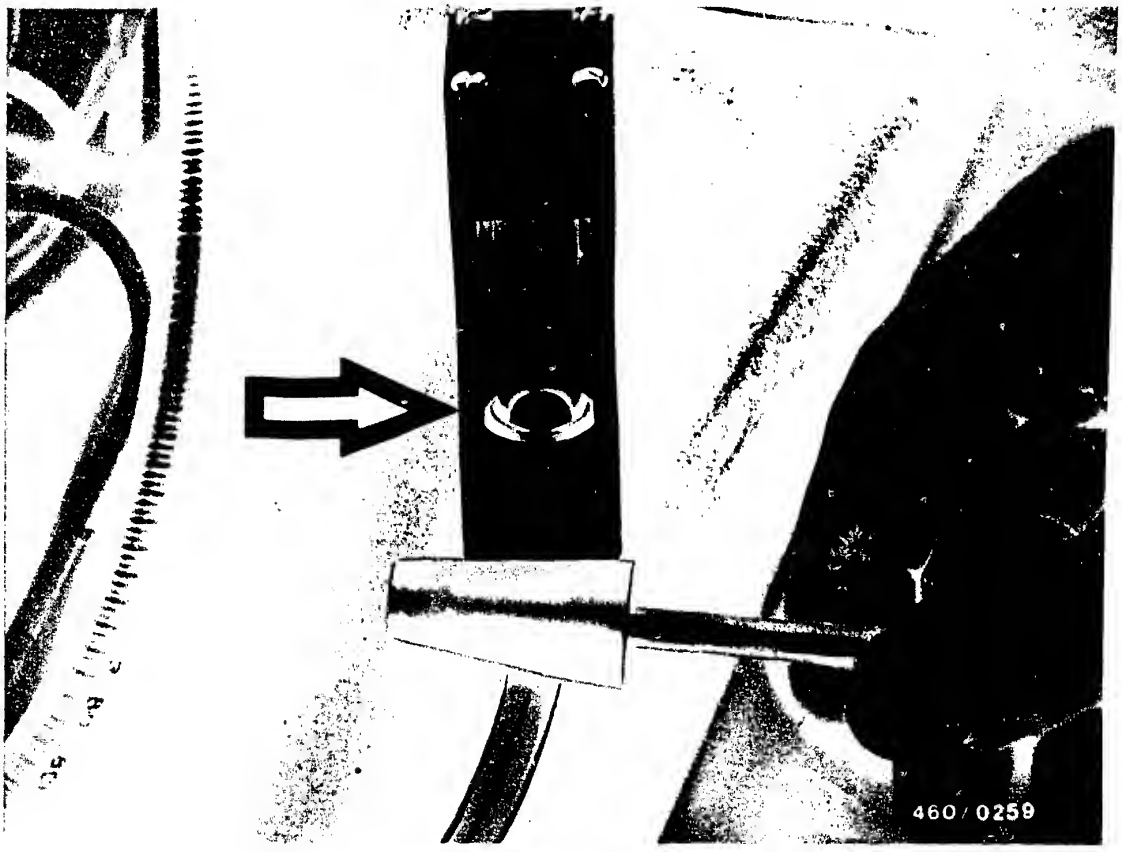
31.2 Measuring the compression loss in the engine

The Bosch compression loss tester 0 681 001 901 (EFAW 210 A) is used for the test.

To test, the cylinder in question must be at the TDC position (TDC = top dead center) of the compression stroke.

To adjust that point, the D.C. detector 1 688 132 025 (included in the accessories for the compression loss tester) is used.

Test with the engine at normal operating temperature (water temperature approx. 80°C).



31.2.1 Setting the TDC

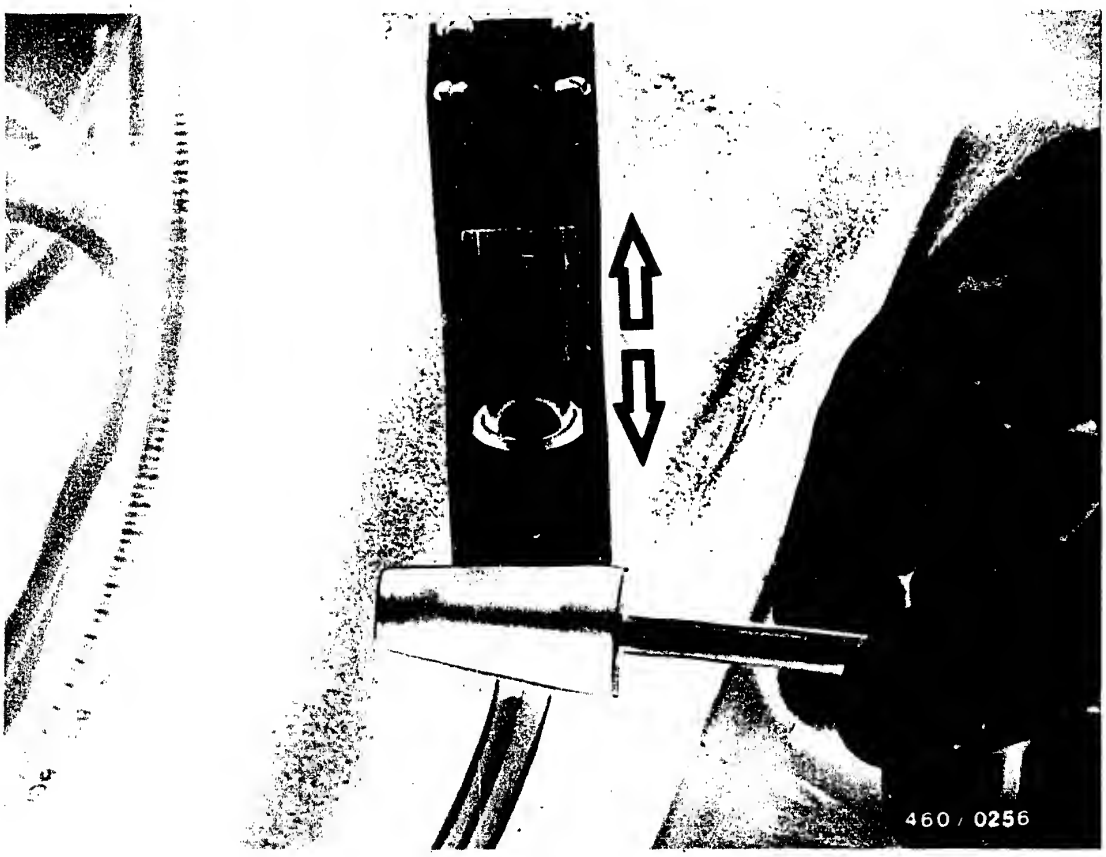
Take out the first cylinder sheathed-element glow plug.

Insert the rubber stopper of the D.C. detector into the hole for the sheathed-element glow plug.

Fasten the glass cylinder on the magnetic bracket in the engine compartment in as vertical a position as possible.

The plunger on the instrument must be clearly visible.

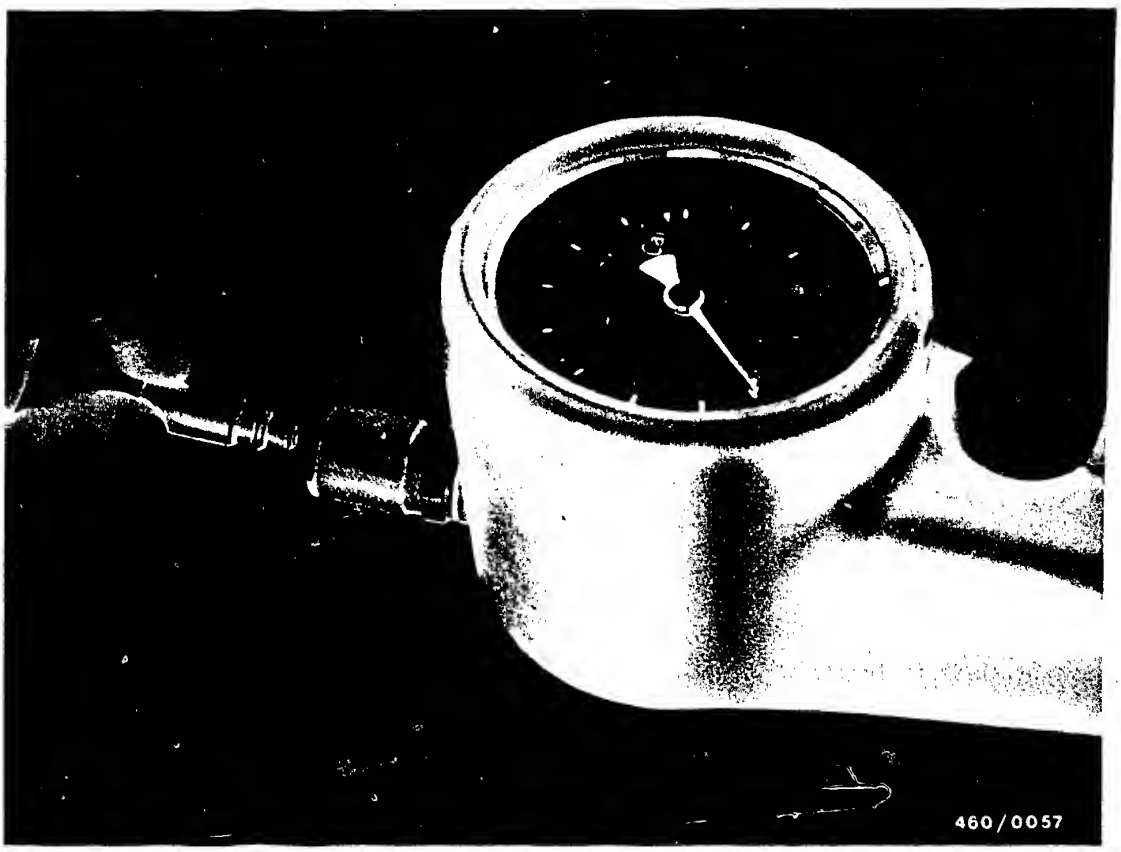
Slowly turn the engine by hand in the direction of engine rotation. (If need be, put into gear and move the vehicle.)



On the compression stroke, the plunger of the D.C. detector is pushed upward.

When the top dead center is passed, the plunger slides immediately downward.

Locate the dead center by moving the engine back and forth carefully.



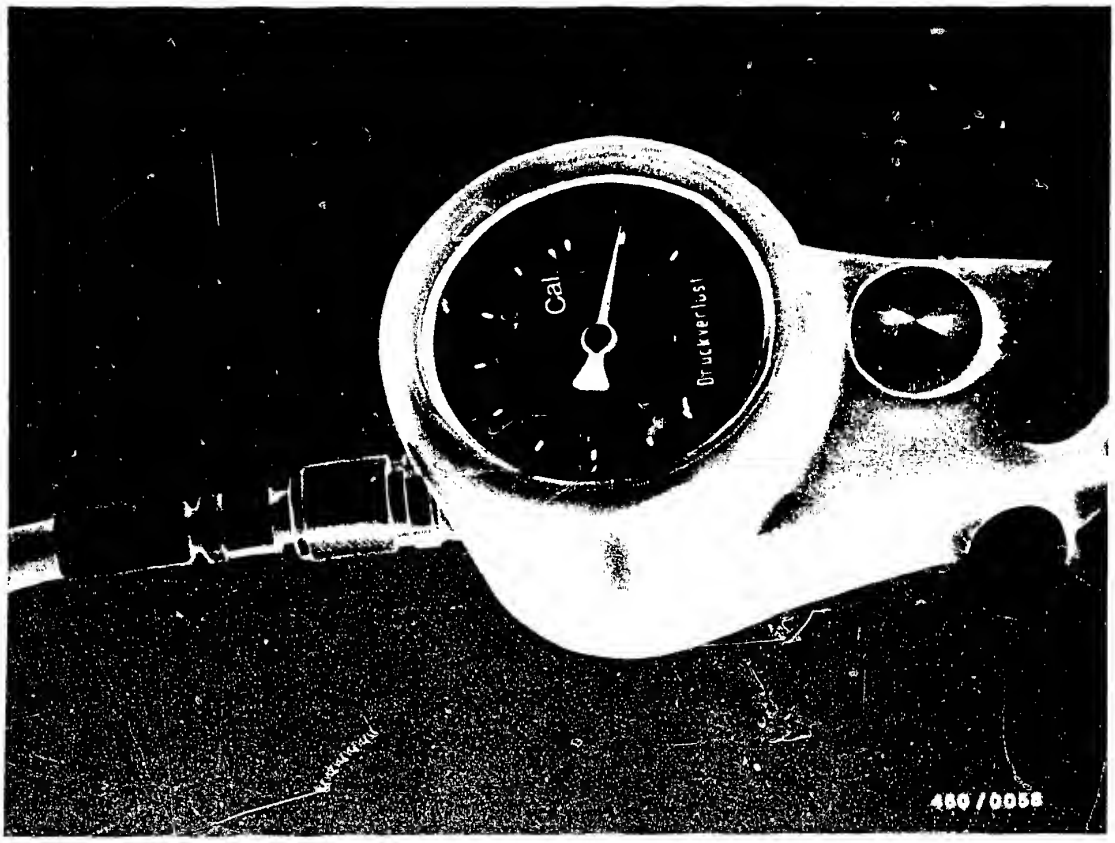
31.2.2 Measuring compression loss

Connect the tester to the existing compressed air system.

Connect up test nozzle 1 680 363 036.

Set a compression loss of 23 ± 1 % (marking "Cal") on the knurled screw of the pressure regulating valve.

(The gauge needle must indicate approximately 0 % compression loss - checking of the instrument.)



Screw in the connecting pipe and put on the test hose.

Shift into gear and apply the handbrake.

Connect the test hose to the tester.

Read the compression loss on the instrument in %.

Note:

Before taking measurement on the next cylinder, run the engine briefly with the starting motor, without pre-heating, in order to restore the oil film.

31.2.3 Evaluation of the test

The reading for compression loss must not exceed 25 %.

Differences between the individual cylinders of 10 % are without significance.

If there are larger leaks, these can be localized because the air coming out causes noise.

Listen at the following points:

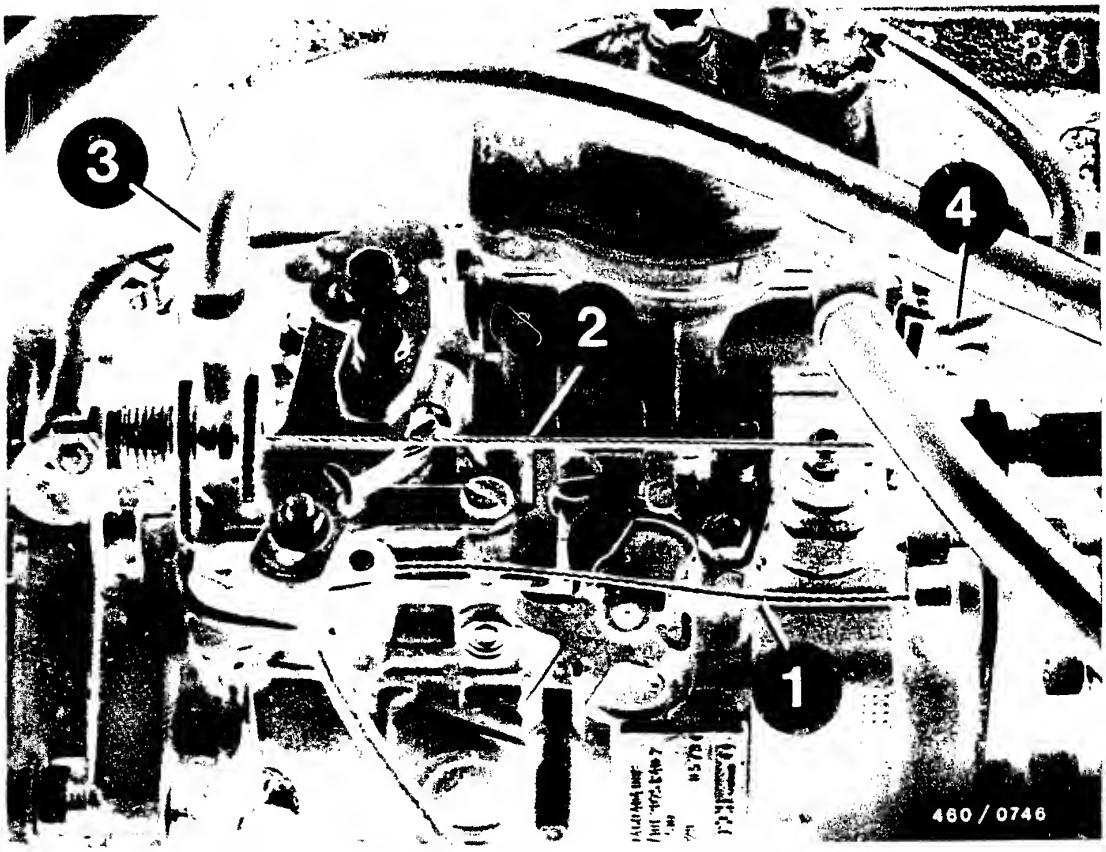
Noise locations	Possible cause of problem
Intake manifold (remove air filter)	Intake valve
Exhaust manifold	Exhaust valve
Oil filling pipe on the engine	Pistons, piston rings
Cooling water filler neck (air bubbles)	Cylinder head gasket

In order to make it easier to locate the source of the problem, put approx. 2...3 cm^3 motor oil into the cylinder.

Repeat the test.

If the compression loss is clearly less during the test, the problem lies with the piston or the piston rings.

In the case of new engines that have not yet been broken in (less than 5000 km), greater compression losses are possible than after the breaking-in time.

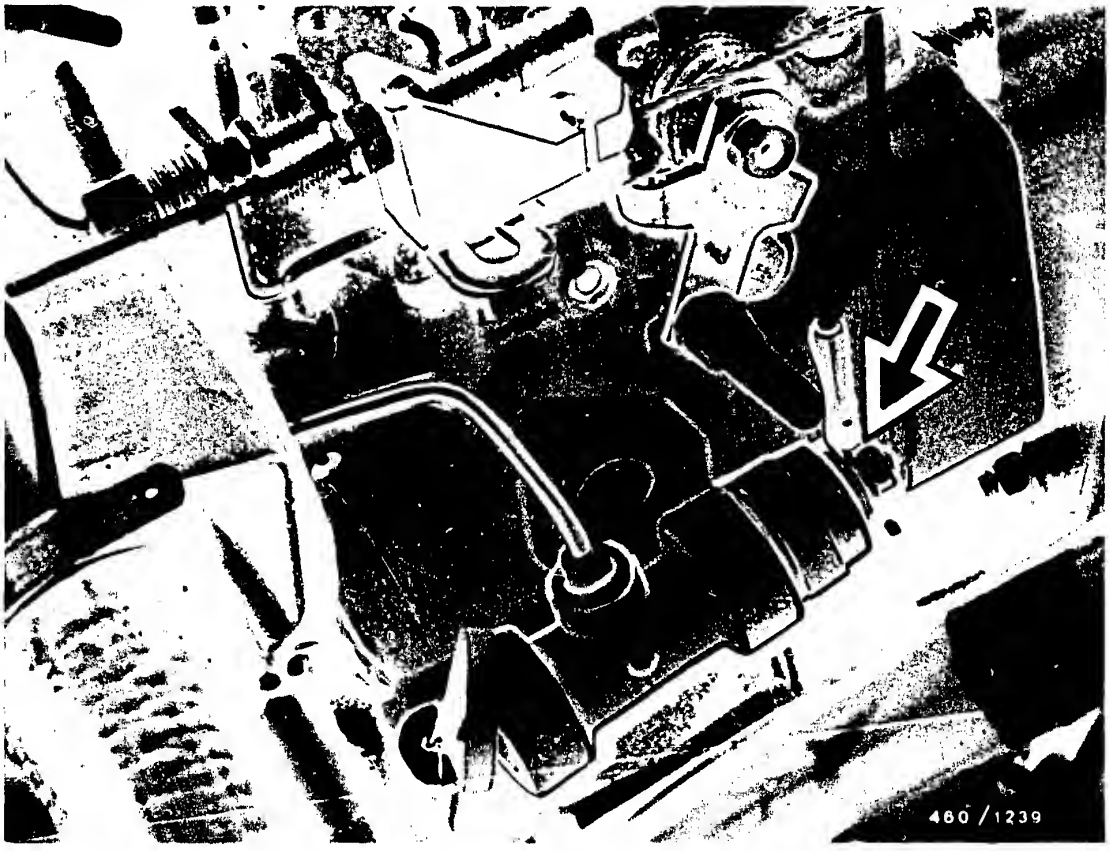


1 = Cable on control lever
2 = Cable for fast idle
3 = Fuel inlet line
4 = Fuel return line

32. Remove fuel-injection pump

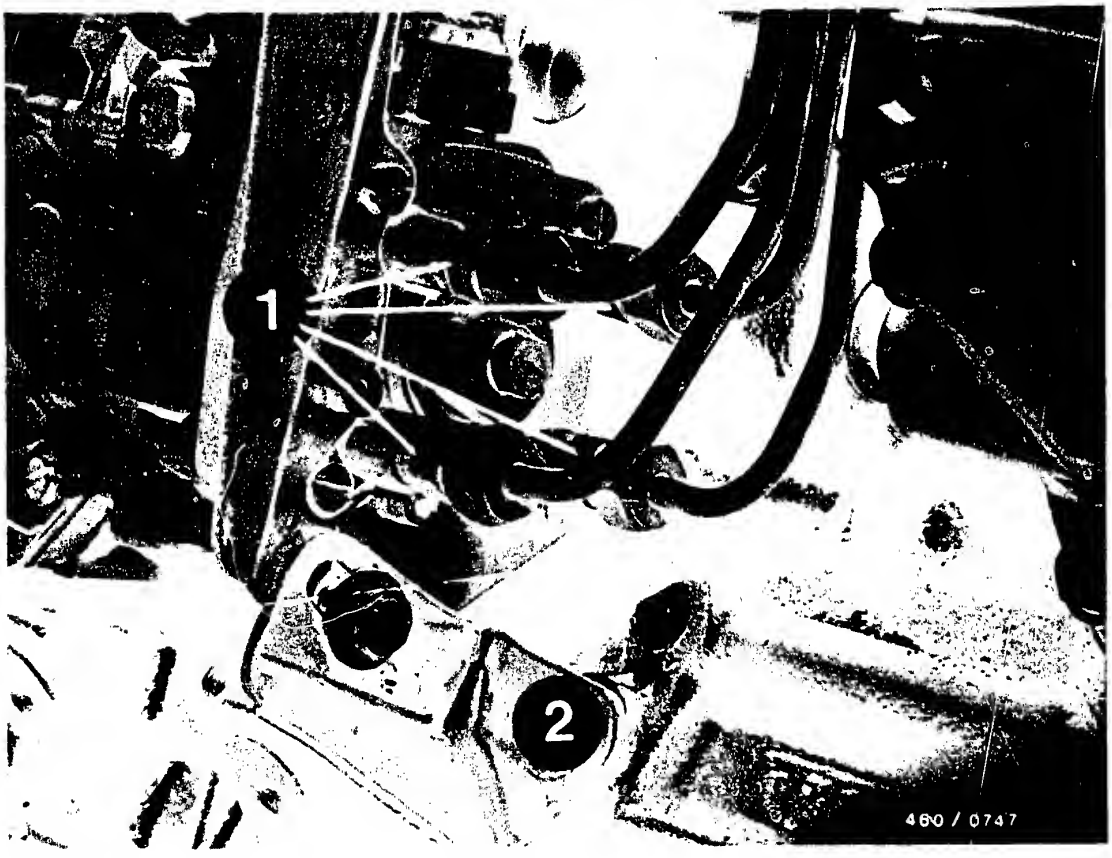
Remove battery and battery bracket.

Remove cable on control lever of injection pump, cable for fast idle (not on engine XD 3T - 2.5 l), fuel inlet line and fuel return line.



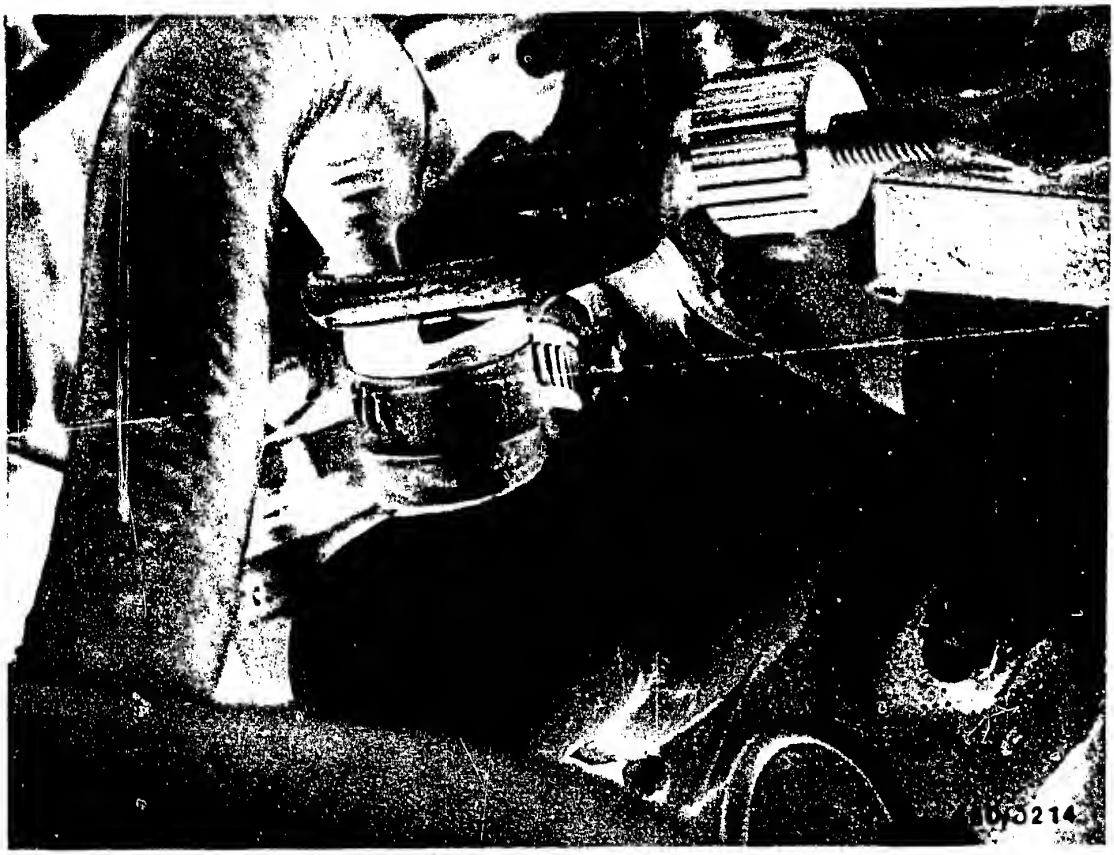
Engine XD 2S only

Remove electric lead from cold-start accelerator (KSB) (see illustration, arrow).



Release the fuel-injection lines (1) using open-end box wrench KDEP 1115. (Prevent the delivery valve holders from becoming loose by holding them with a wrench.)

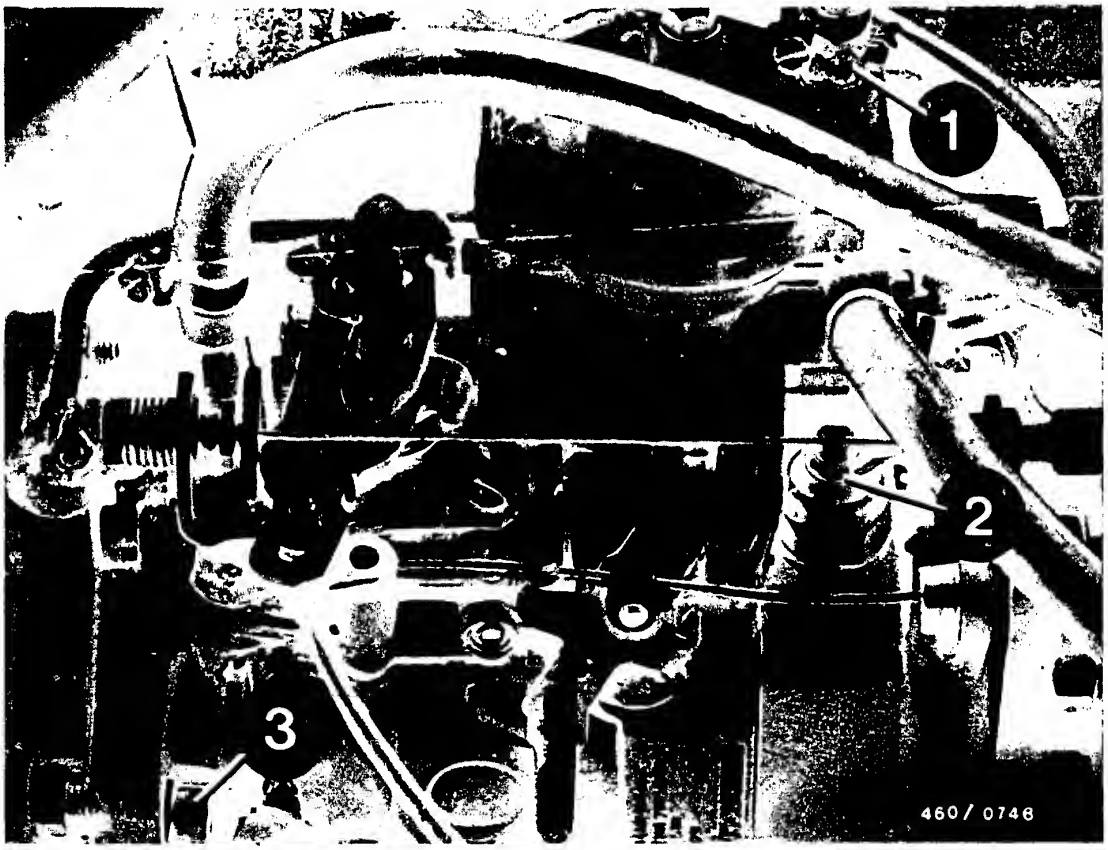
Remove the support bracket (2) on the hydraulic head.



XD 3 T - engine only

Pinch off the cooling water hoses close behind the control device for the fuel-injection pump, using commercially available pinching clamps (see the Figure).

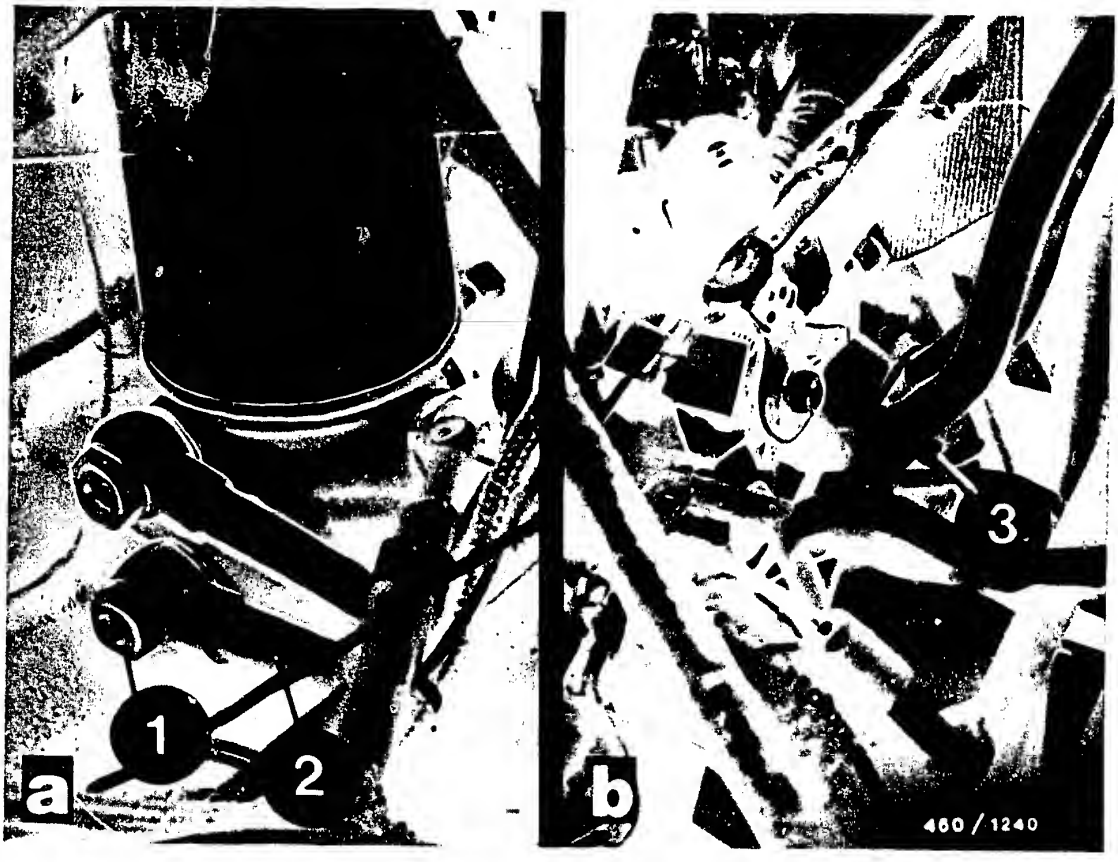
Release the hose clamps and take off the cooling water hoses.



1 = Charge-air pressure connection piece
2 = Shutoff device
3 = Fastening screw

Remove charge-air pressure connection piece, lead for electric shutoff device and injection-pump fastening screws.

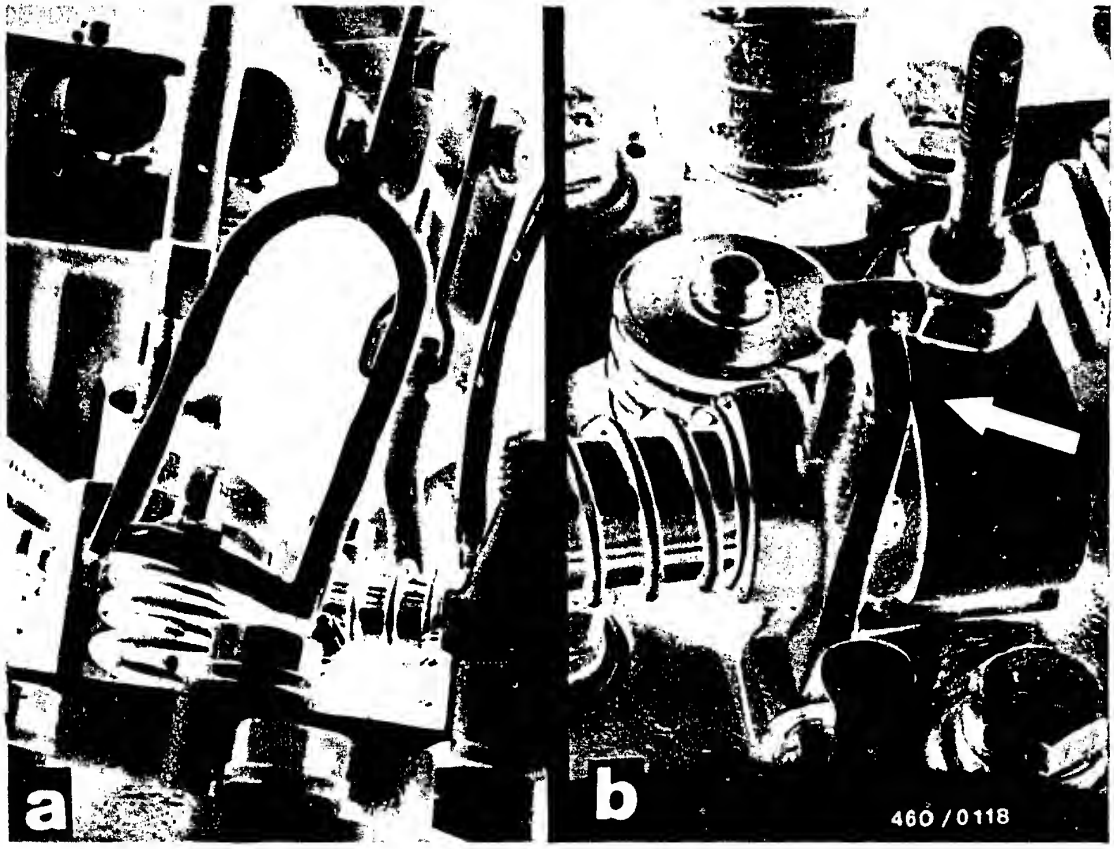
Remove pump from engine, paying attention to the gasket.



1 = Lower fastening screw
2 = Line
3 = Fastening clamp

33. Install fuel-injection pump

Remove funnel for fan.
Remove cylinder head cover.
Unscrew lower fastening screw on oil filter.
Loosen fastening clamp and lay line to one side.

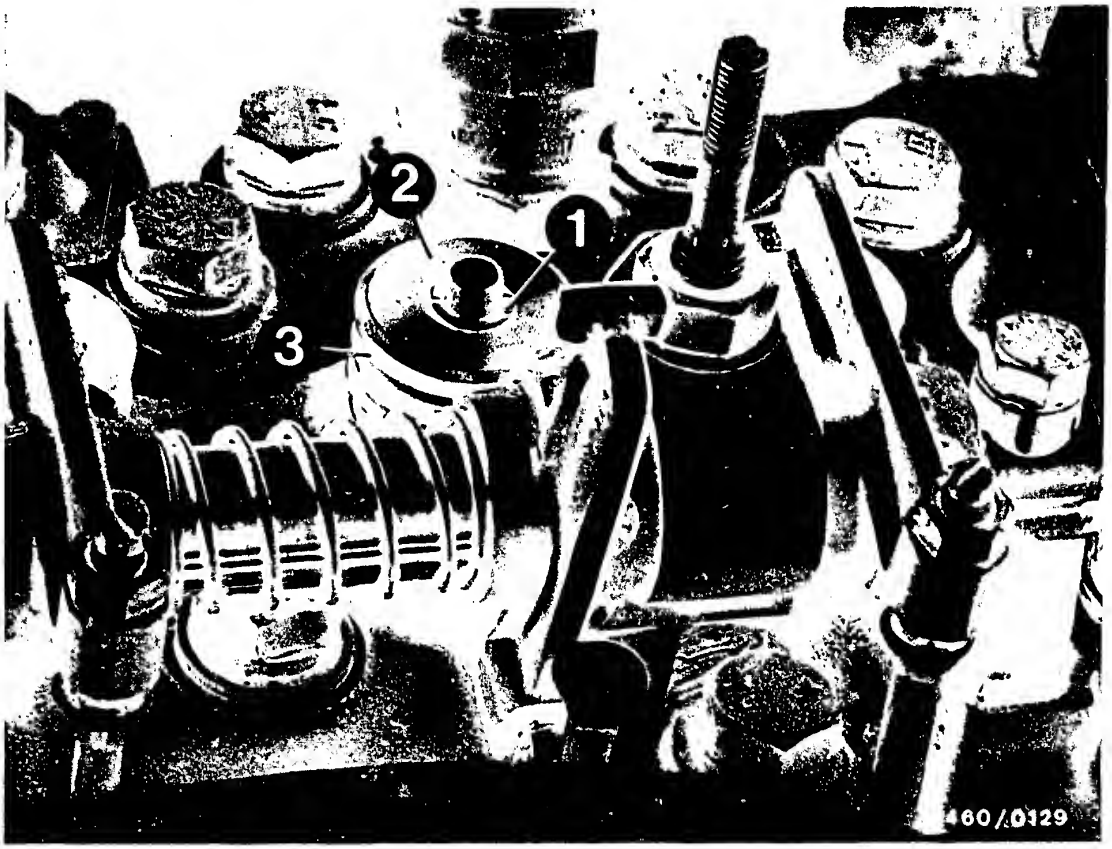


Using box wrench, turn crankshaft so that exhaust valve just opens with cylinder 1 in BDC position.

Insert tool 8.0105 Y into the rocker arm shaft and press the spring of the exhaust valve on the 4th cylinder down (Figure, a).

Shove the rocker arm in so doing against the pressure spring on the rocker arm shaft, and set it up in a vertical position.

In that position, move it to its initial location (Figure, b).



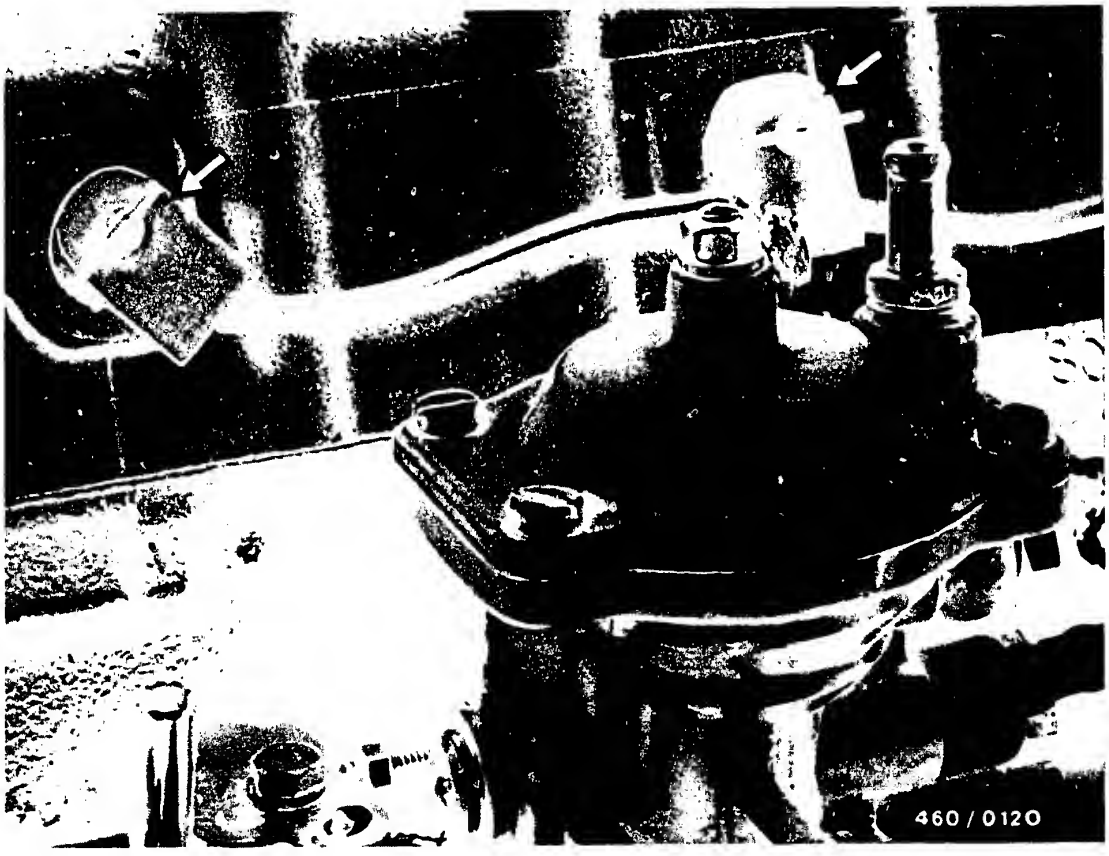
Turn the crankshaft in the direction of engine rotation until the 4th cylinder is in the TDC position.

When this is done, the valves of the 1st cylinder are at overlap.

Press the valve spring for the exhaust valve of the 4th cylinder down using tool 8.0105 Y.

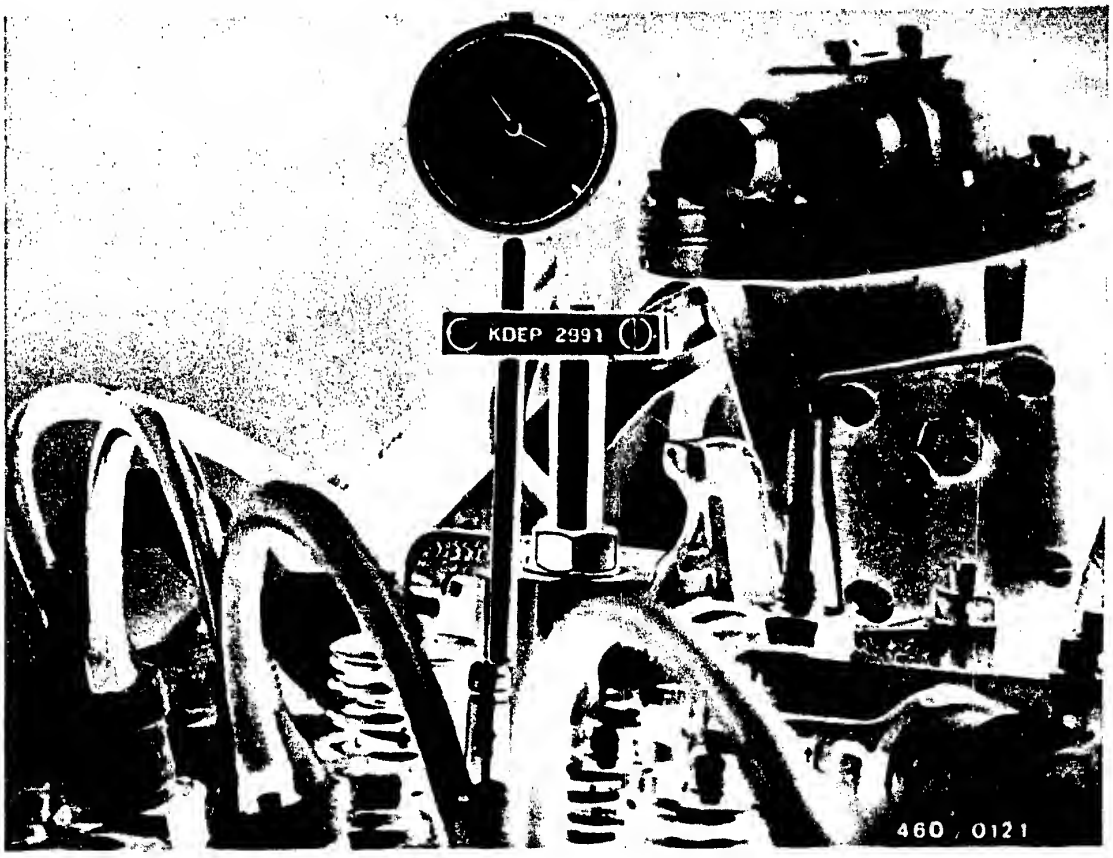
Remove the valve collets (1) from the exhaust valve.

Release the valve spring, remove the spring plate (2) and the valve spring (3) from the valve.



The exhaust valve of the 4th cylinder now lies up against the engine piston.

Take out the sheathed-element glow plugs for the 3rd and 4th cylinders (arrows).



Screw measuring tool KDEP 2991 on the threaded bolt of the 4th cylinder.

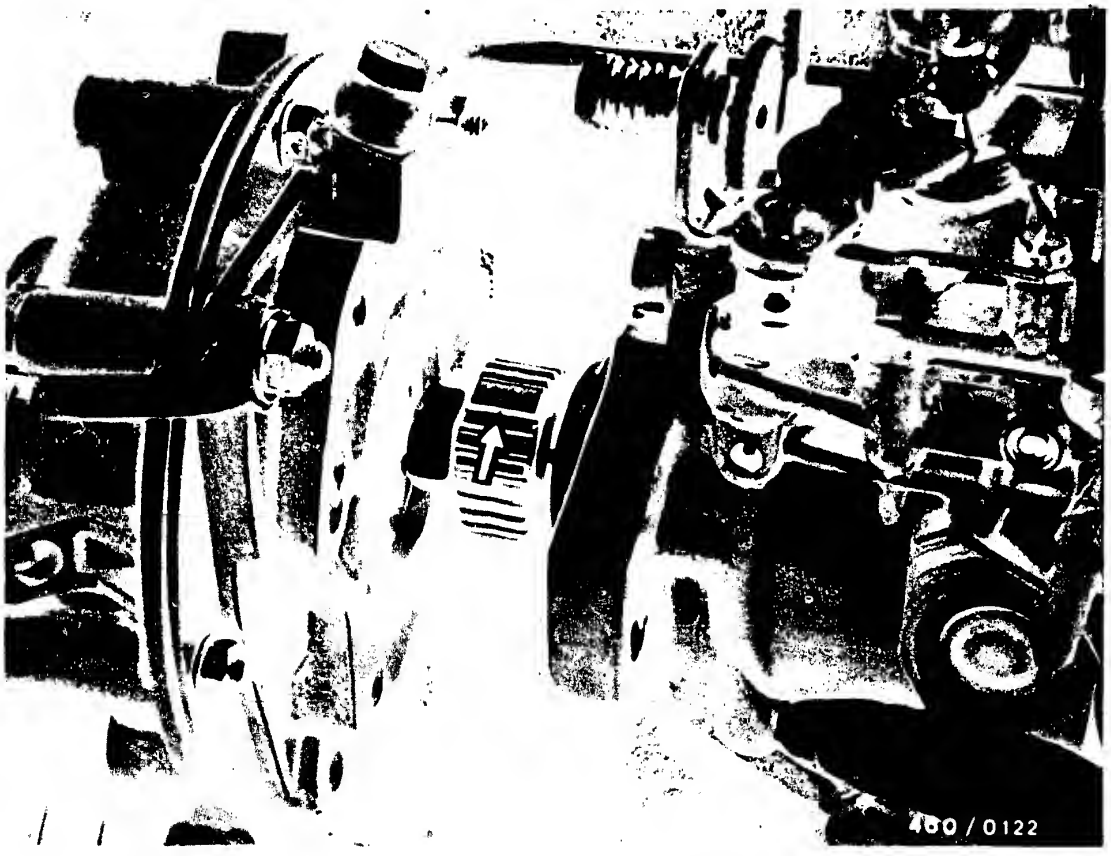
Clamp the dial indicator 1 687 233 012 with the long measuring base into measuring tool KDEP 2991.

The measuring base lies on the exhaust valve of the 4th cylinder. Prestress the dial indicator approx. 10 mm.

Turn the crankshaft counter to the direction of engine rotation until the piston has made a stroke of approx. 7 mm.

Turn the crankshaft back in the direction of engine rotation to the TDC setting of the 4th cylinder.

Set the dial indicator at "0".

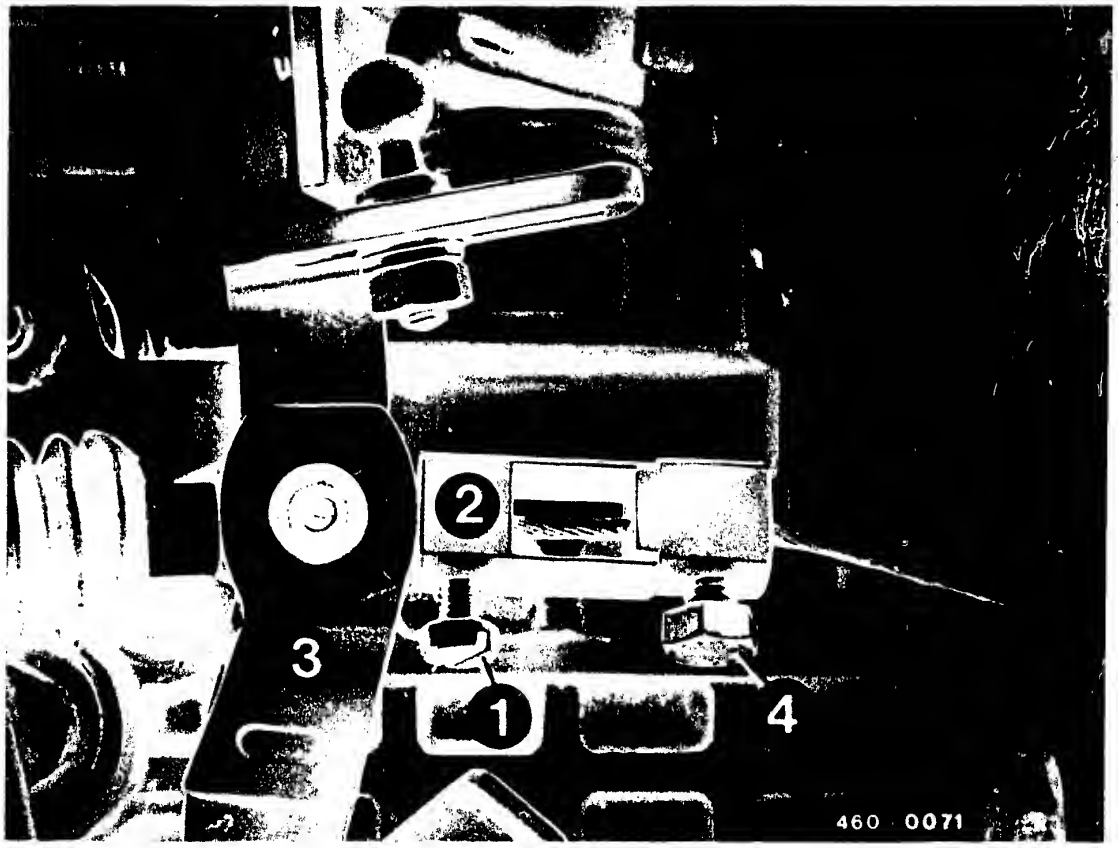


Turn the drive shaft of the fuel-injection pump so that the marking on the drive pinion points approximately in the direction of outlet "B" (see the Figure, arrow).

Glue on a new paper gasket with grease to the attachment flange for the fuel-injection pump.

Insert the fuel-injection pump into the socket of the engine.

Provisionally tighten the fastening screws (with the socket hex) of the fuel-injection pump.



XD 3 T - 2.5 l engine only

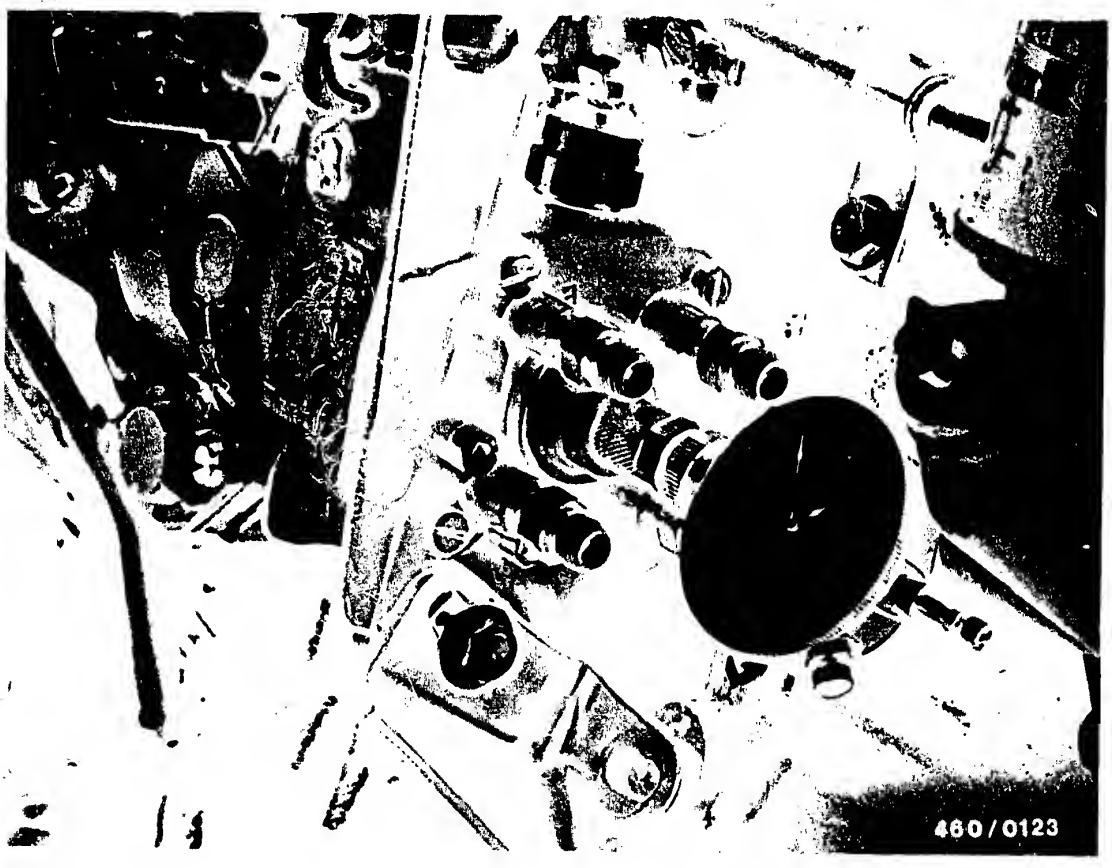
In order to test and adjust the start of fuel delivery, the temperature-controlled cold-start accelerator (KSB) must be in its zero position.

For this, release the clamping screw (1) on the fuel-injection pump.

Pull the spacer piece (2) and the control lever (3) toward the hydraulic head.

Turn the spacer piece (2) by 90° and shove it back toward the drive shaft until the control lever (3) is up against the stop bracket.
In this position, the control device is switched off.

Note:
Do not release the locking screw (4) or it will be necessary to readjust the control device.



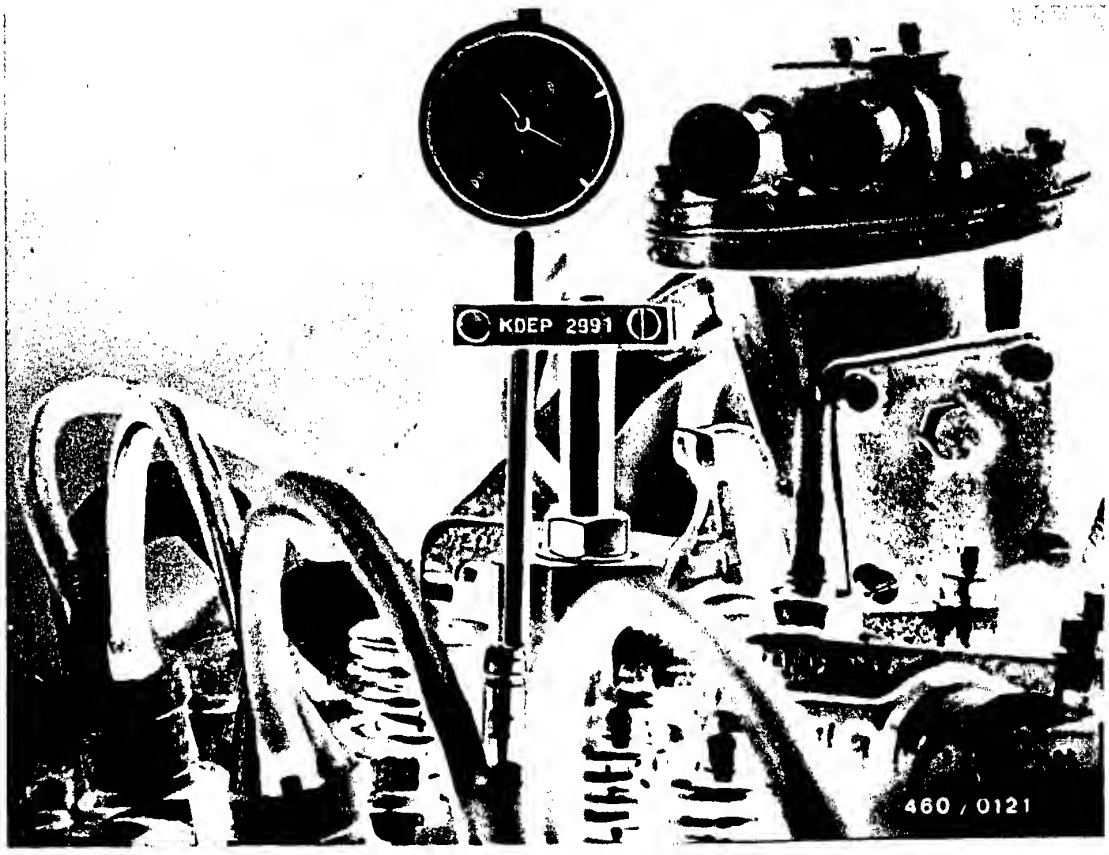
Remove the bleeder screw from the central screw plug (triangular screw) of the fuel-injection pump.

Screw measuring tool KDEP 1085 into the hole for the bleeder screw.

Put on dial indicator 1 687 233 011 or .. 012 with the measuring base, and prestress it approx. 3 mm (see pic.)

Turn the crankshaft counter to the direction of engine rotation until the dial indicator shows the BDC position for the plunger of the fuel-injection pump.

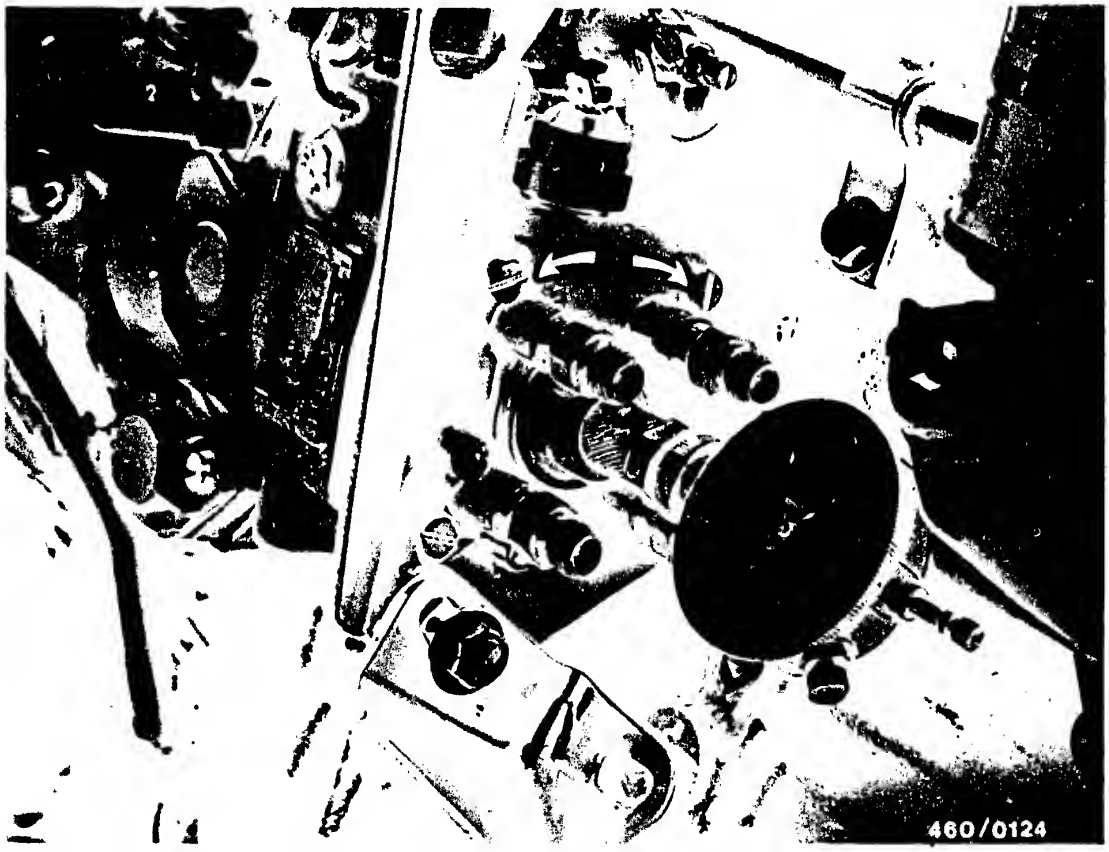
Set the dial indicator at 0.



Turn the crankshaft in the direction of engine rotation until the dial indicator on the exhaust valve of the 4th cylinder indicates a piston stroke of

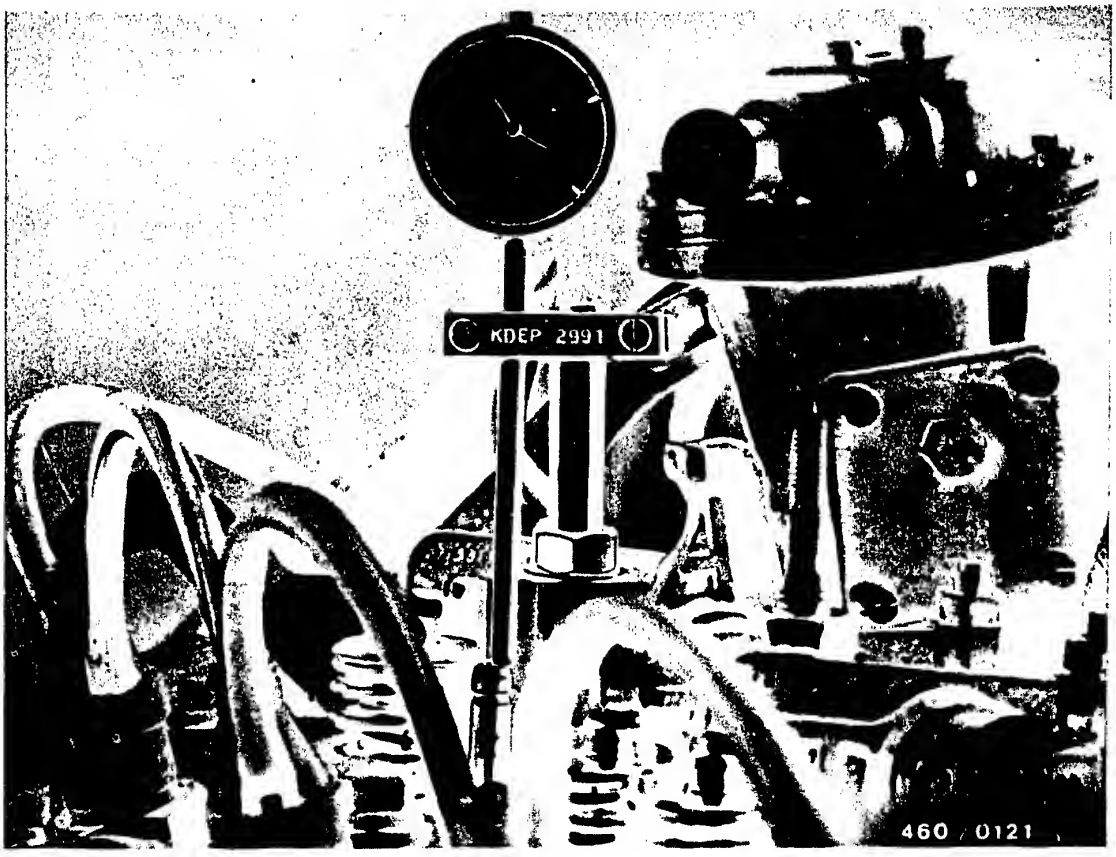
505/604 D-Turbo Engine XD 2S - 2.3 l Automatic	0.51 mm
505/604 D-Turbo Engine XD 3T - 2.5 l	0.89 mm
505/604 D-Turbo Engine XD 3T - 2.5 l Automatic	0.57 mm

before TDC.



With the piston settings as indicated, the dial indicator on the fuel-injection pump must indicate a pump plunger stroke of 0.48...0.52 mm ABDC.

If need be, adjust the stroke by pivoting fuel-injection pump. To do this, the fastening screws on the fuel-injection must be released.
(Loosen injection-pump fastening screws also on support bracket.)
Then retighten the fastening screws to 20 Nm.

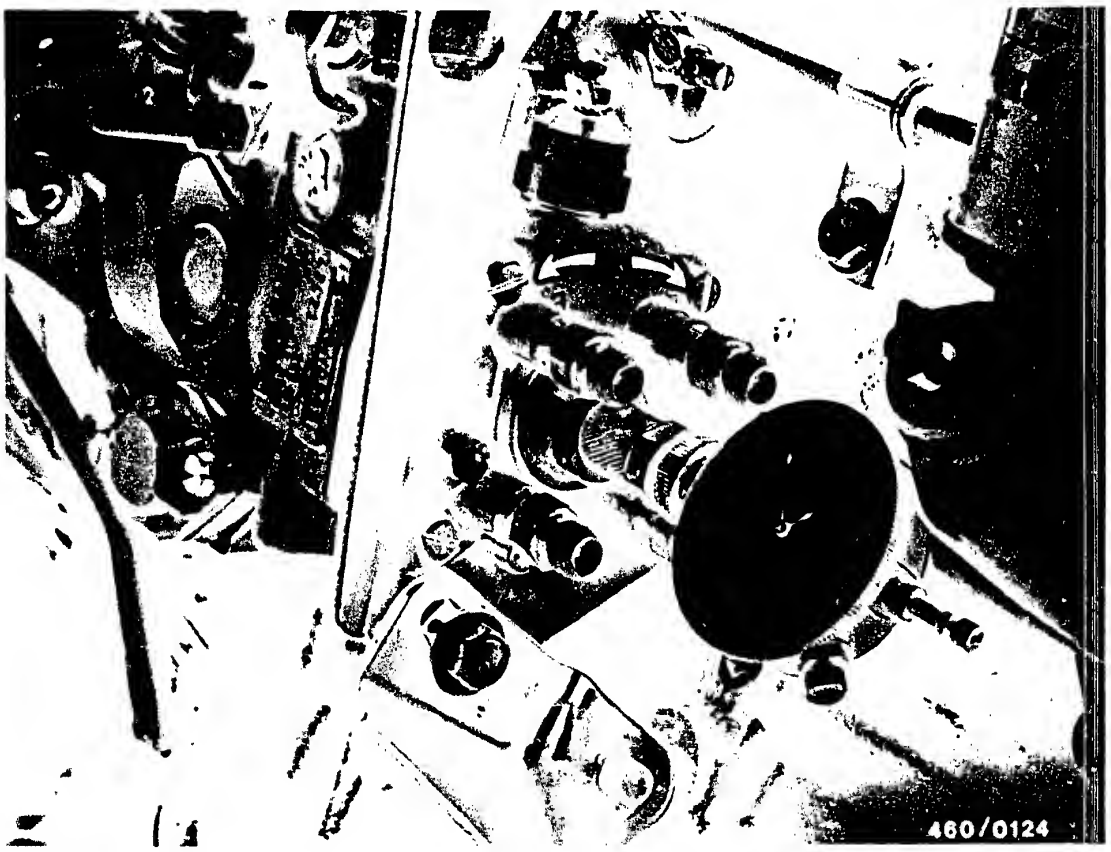


Checking the adjustment of the fuel-injection pump with respect to the engine

Turn the engine crankshaft in the direction of engine rotation as far as the TDC setting of the 4th cylinder.

Check the 0-setting of the dial indicator on the exhaust valve.

Turn the crankshaft counter to the direction of engine rotation until the dial indicator shows a stroke of approx. 7 mm (7 rotations of the needle).

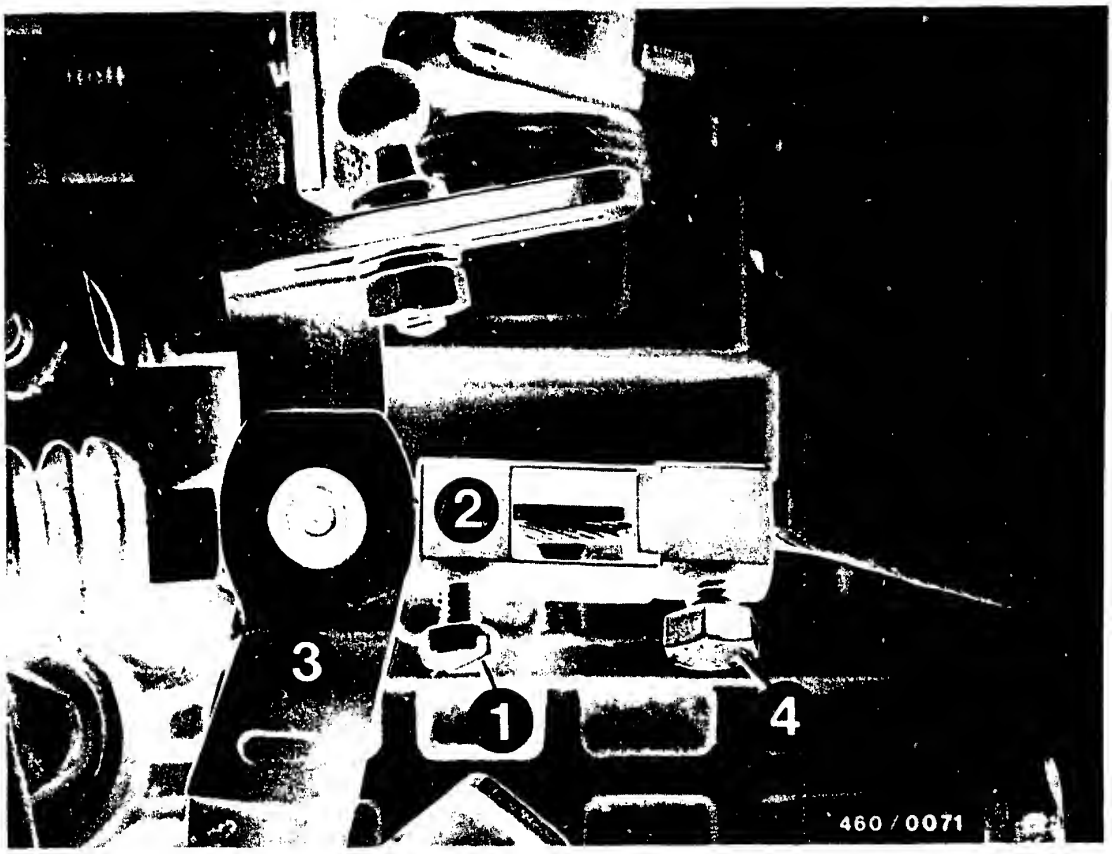


Turn the crankshaft in the direction of engine rotation until the dial indicator on the fuel-injection pump shows a stroke of 0.50 mm.

In this setting, the piston of the 4th cylinder must be

505/604 D-Turbo Engine XD 2S - 2.3 l Automatic	0.49...0.53 mm
505/604 D-Turbo Engine XD 3T - 2.5 l	0.87...0.91 mm
505/604 D-Turbo Engine XD 3T - 2.5 l Automatic	0.55...0.59 mm

before TDC.



XD 3 T - 2.5 l engine only

Pull the control lever (3) and the spacer piece (2) toward the hydraulic head.

Turn the spacer piece (2) by 90° and shove it back toward the drive shaft.

The spacer piece is now in its initial position.

Tighten the clamping screw (1).

Caution:

Do not release the locking screw (4) or it will be necessary to readjust the control device.

Remove measuring tool KDEP 1085 and dial indicator on the fuel-injection pump.

Put the bleeder screw back on using a new copper gasket ring.

Tighten the fuel-injection pump fastening screws to 20 Nm.

Bring the engine piston of the 4th cylinder into the TDC setting.

Remove the measuring tool KDEP 2991 and the dial indicator.

Put the valve spring and the upper valve plate on the 4th cylinder exhaust valve.

Press the valve spring down using tool 8.0105 Y.

Put in the exhaust valve collets. Relax the valve spring.

Turn the crankshaft so that the exhaust valve of the 1st cylinder just opens with the piston at BDC.

Press the valve spring of the 4th cylinder exhaust valve down using the spring plate.

Shove the rocker arm against the spring in the rocker arm shaft, and put it into a horizontal position.

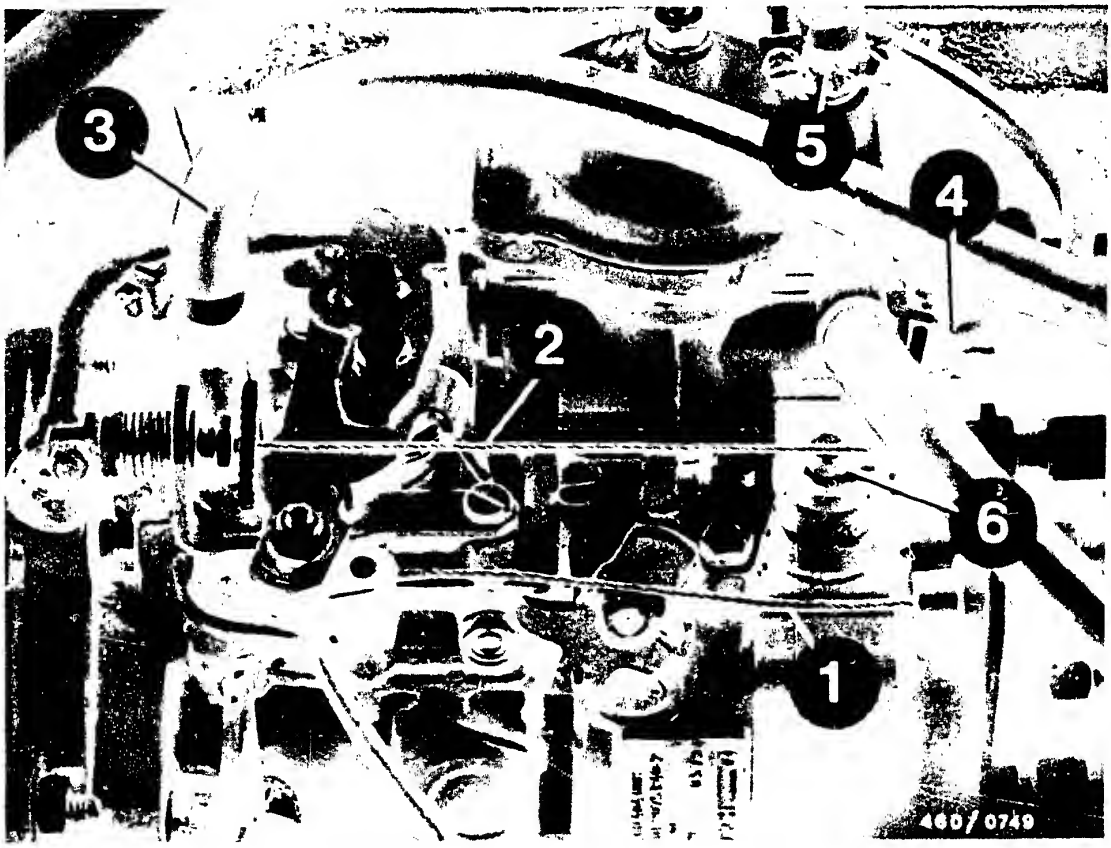
In that position, put the rocker arm on the exhaust valve and tappet.

Remove tool 8.0105 Y.

Check the valve clearance:

Check the valve clearance only with engine cold (min. 6 hrs. at rest)

Inlet valve:	0.15 mm
Exhaust:	0.25 mm

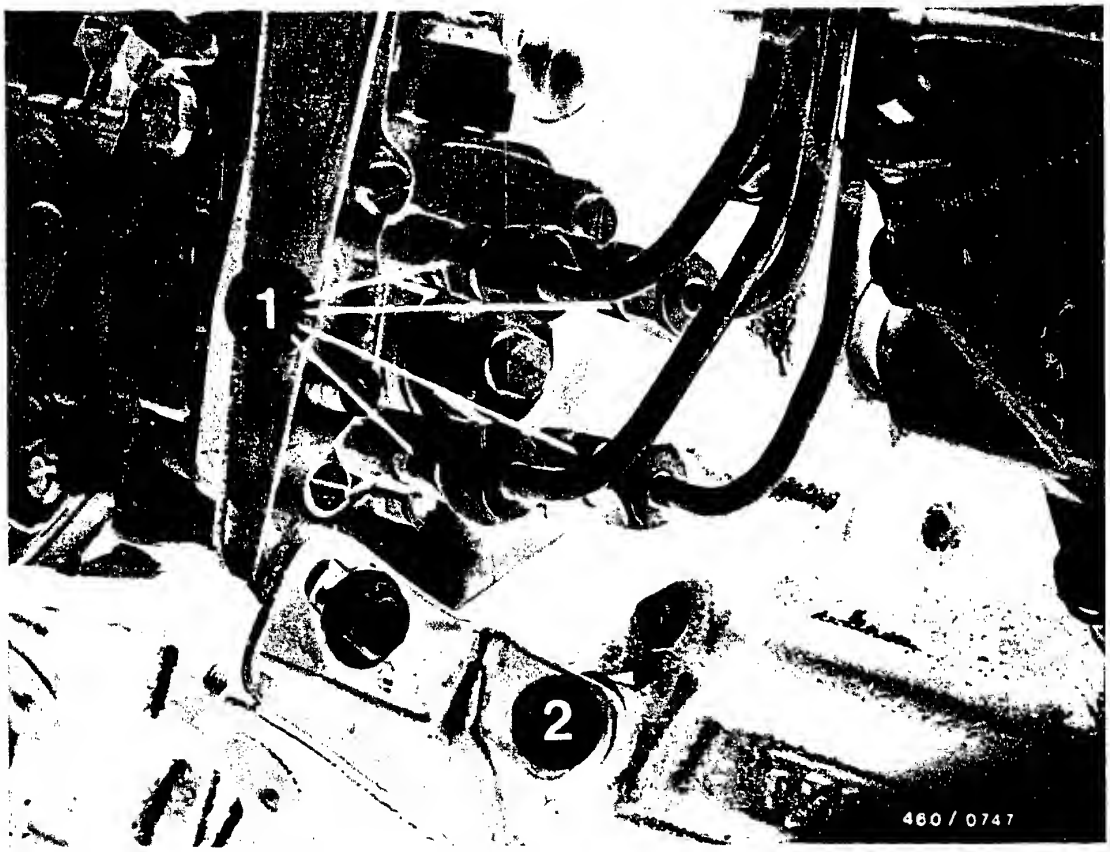


1 = Control lever cable
2 = Fast idle cable
3 = Fuel inlet line
4 = Fuel return line
5 = Charge-air pressure connection
6 = Shutoff device

Mount cable on injection-pump control lever, cable for fast idle, fuel inlet line, fuel return line, hose connection for charge-air pressure and lead for electric shutoff device.

Note:

It is not permissible to exchange the inlet-union screws for the fuel supply and return lines one for the other. The inlet-union screw for the return line has throttle holes and is identified with the word "out" on the head of the screw.



Tighten the fuel-injection lines (1) using open-end box wrench KDEP 1115. (Prevent the delivery valve holders from turning by holding them with a wrench.)

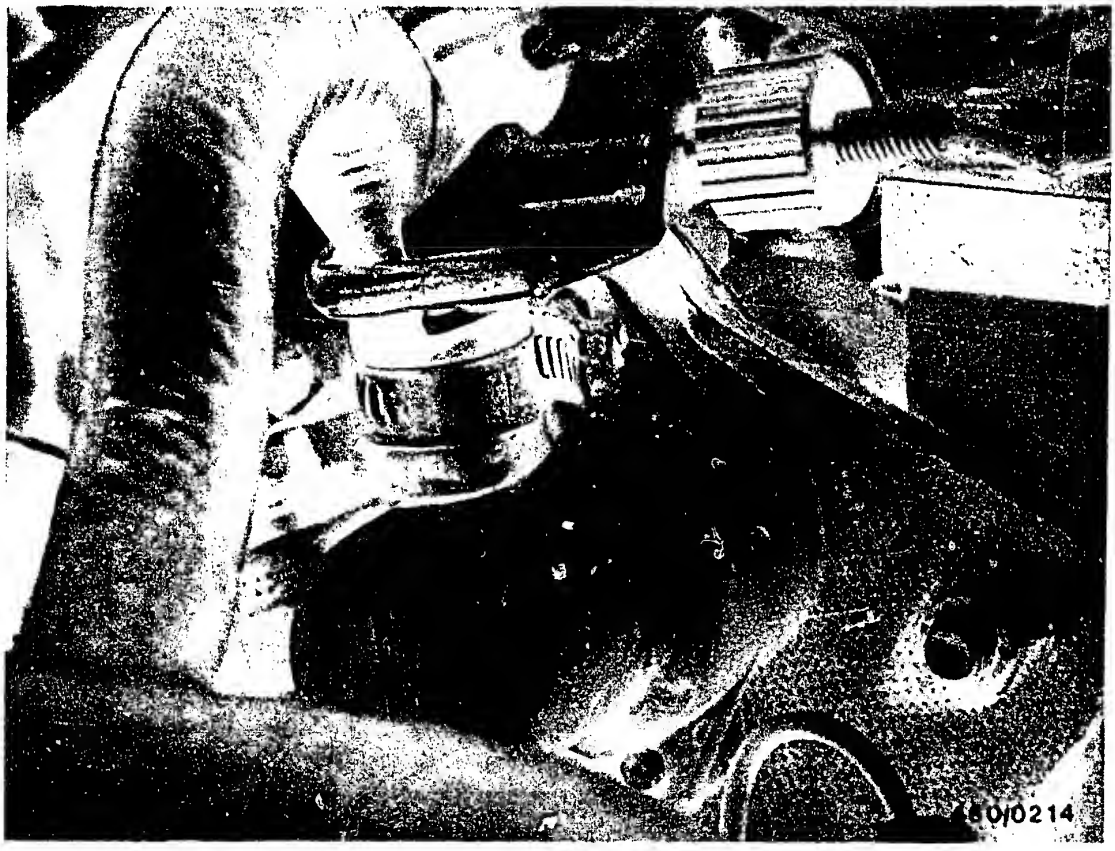
Adjust the support bracket (2) on the fuel-injection pump hydraulic head in such a way that it touches stress-free against the cylinder block and the hydraulic head.

Tighten support bracket.

Put on the line from the oil cooler to the oil filter, cylinder head cover, and fan funnel.

Put in the sheathed-element glow plugs for the 3rd and 4th cylinders.

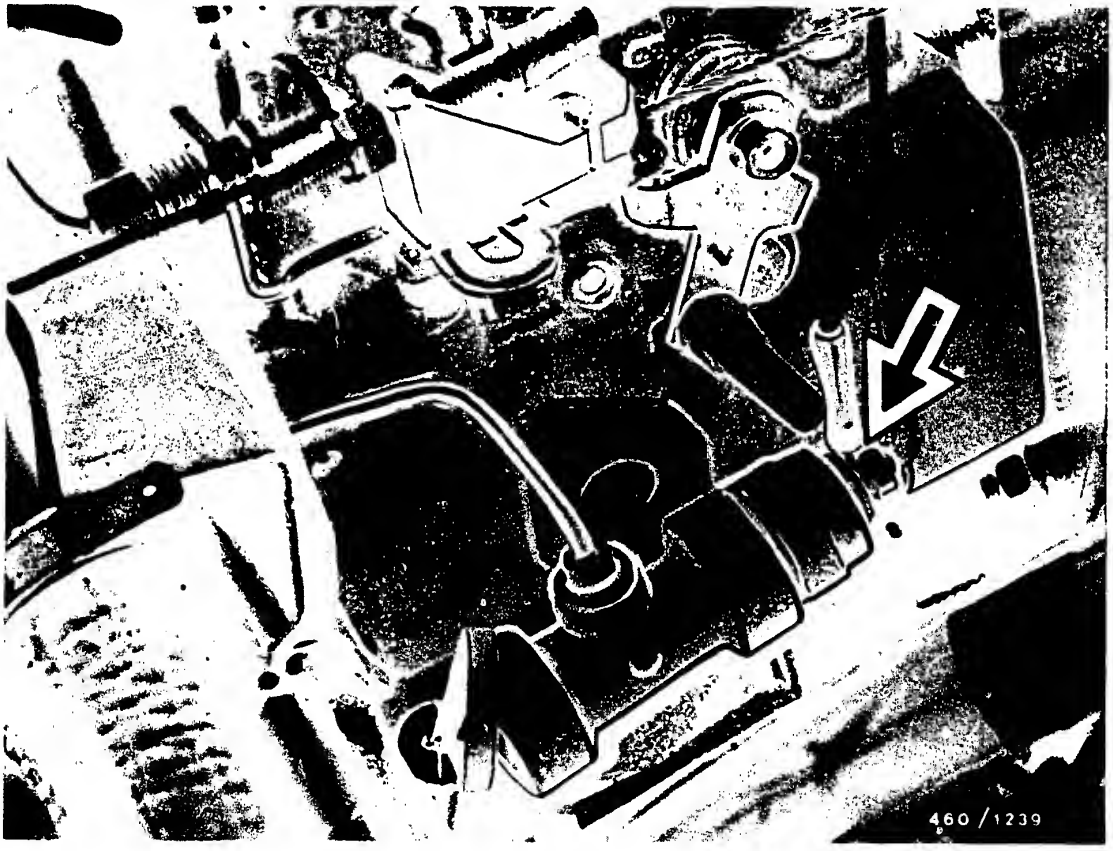
Screw in the battery bracket, install the battery, and connect it.



XD 3 T - 2.5 l engine only

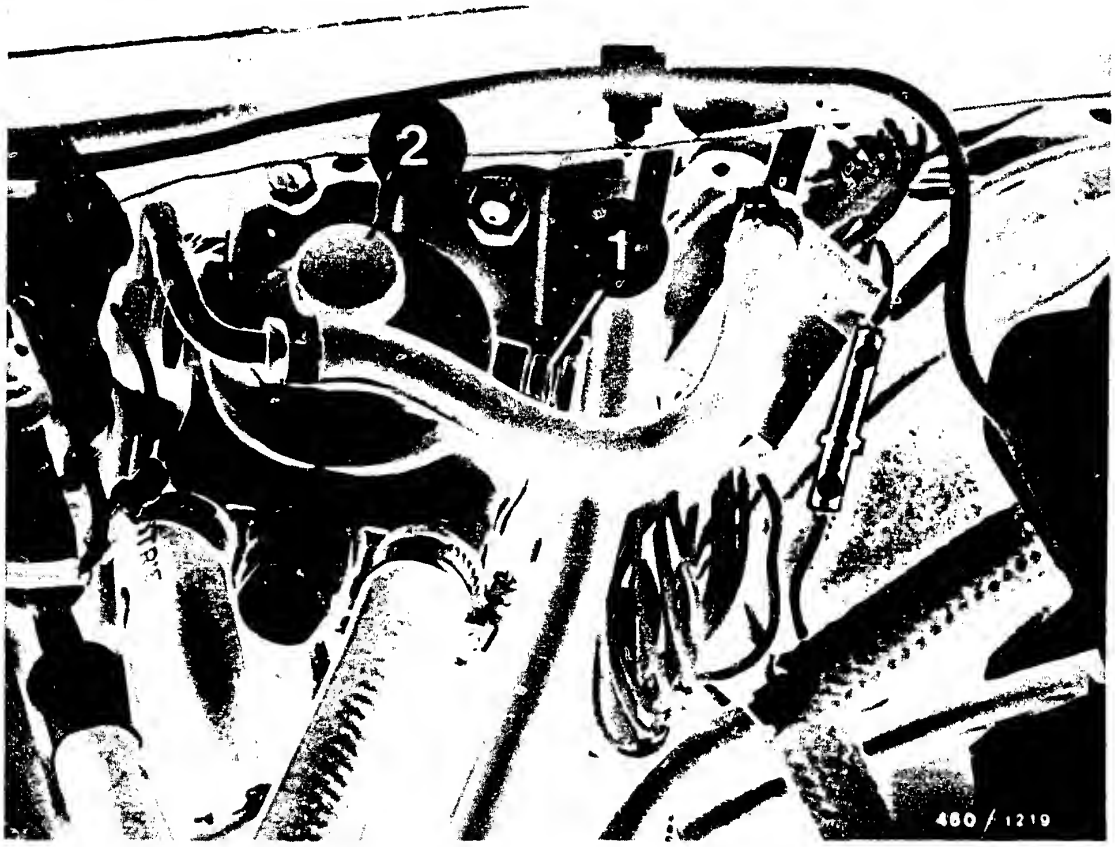
Connect the coolant lines to the control device for the fuel-injection pump and remove the pinching clamps.

Tighten the hose clamps.



Engine XD 2S - 2.3 l only

Mount electric lead on cold-start accelerator (KSB) (see illustration, arrow).

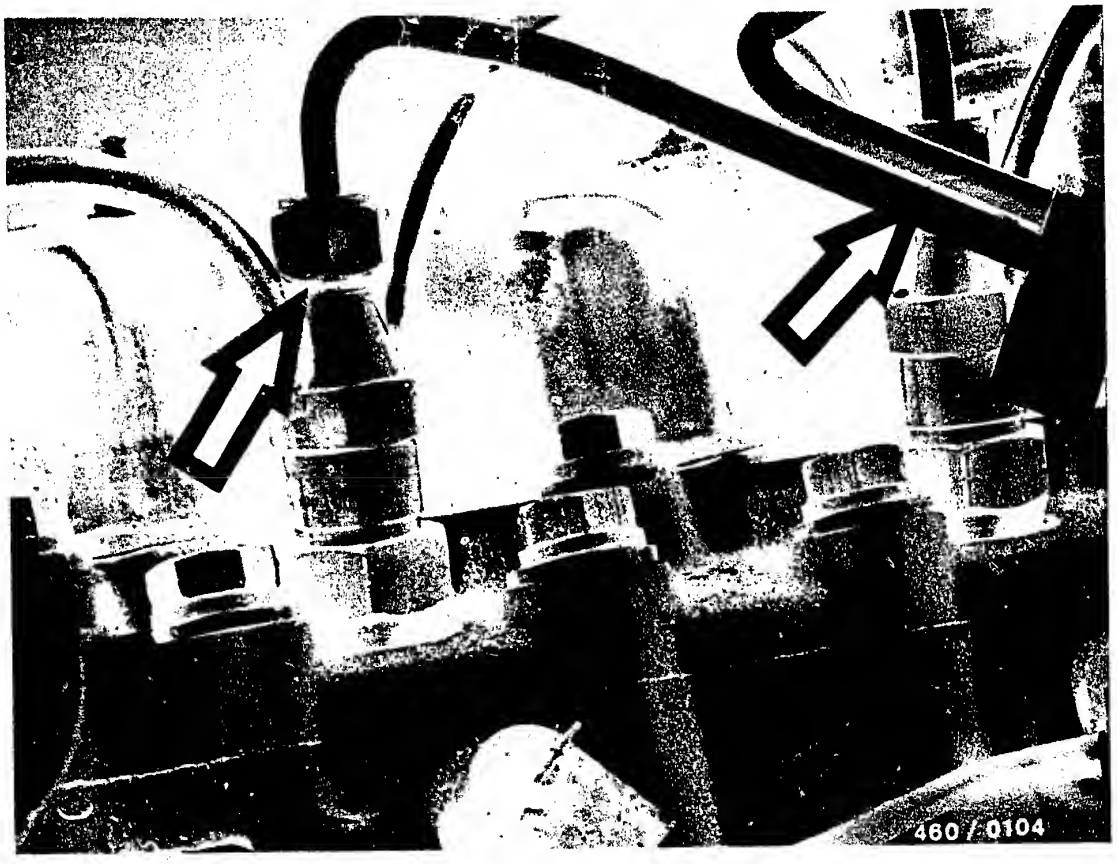


33.1 Bleeding the fuel system

Release the bleeder screw (1) and operate the handpump (2) until the fuel coming out at the bleeder screw (1) is free of bubbles.

Retighten the bleeder screw (1).

Continue working the handpump (2), until resistance is felt.

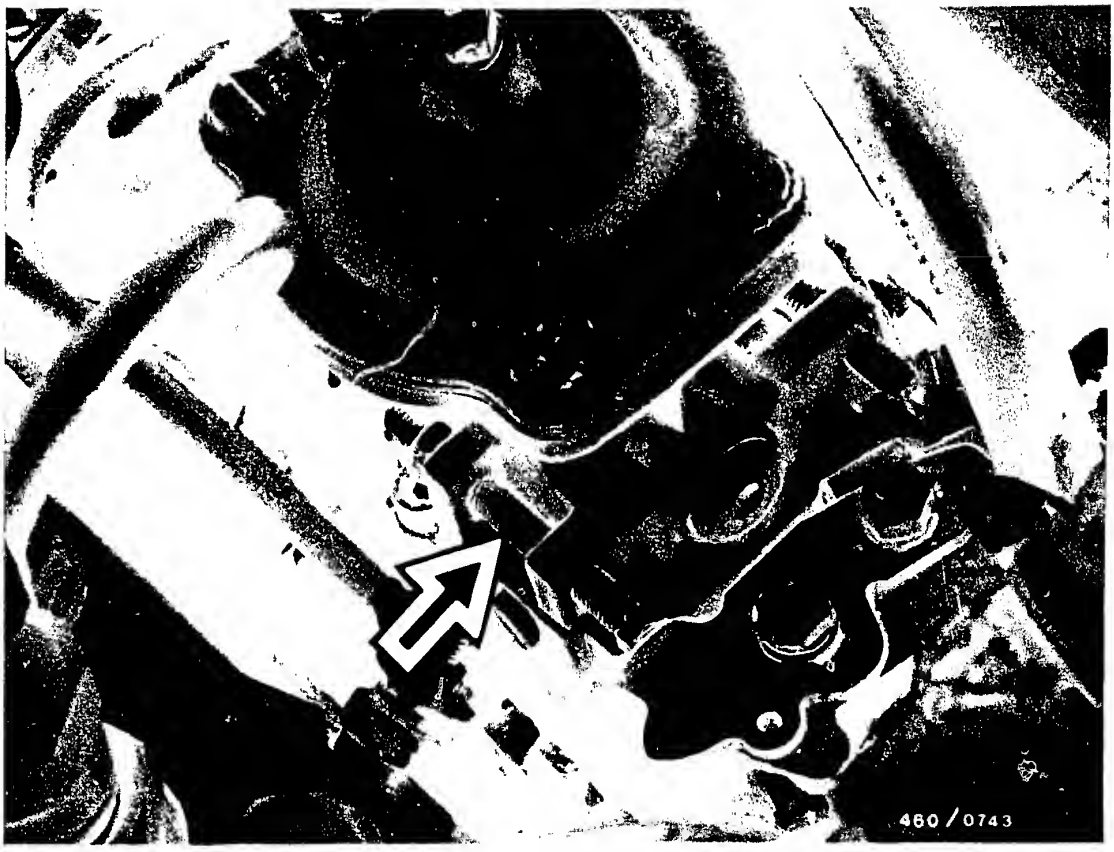


Release the fuel delivery line union nuts at the fuel-injection nozzle holder assemblies (see illustr., arrows).

Operate the engine starting motor without preheating until fuel comes out at the fuel-injection nozzle holder assembly union nuts.

Tighten the union nuts.

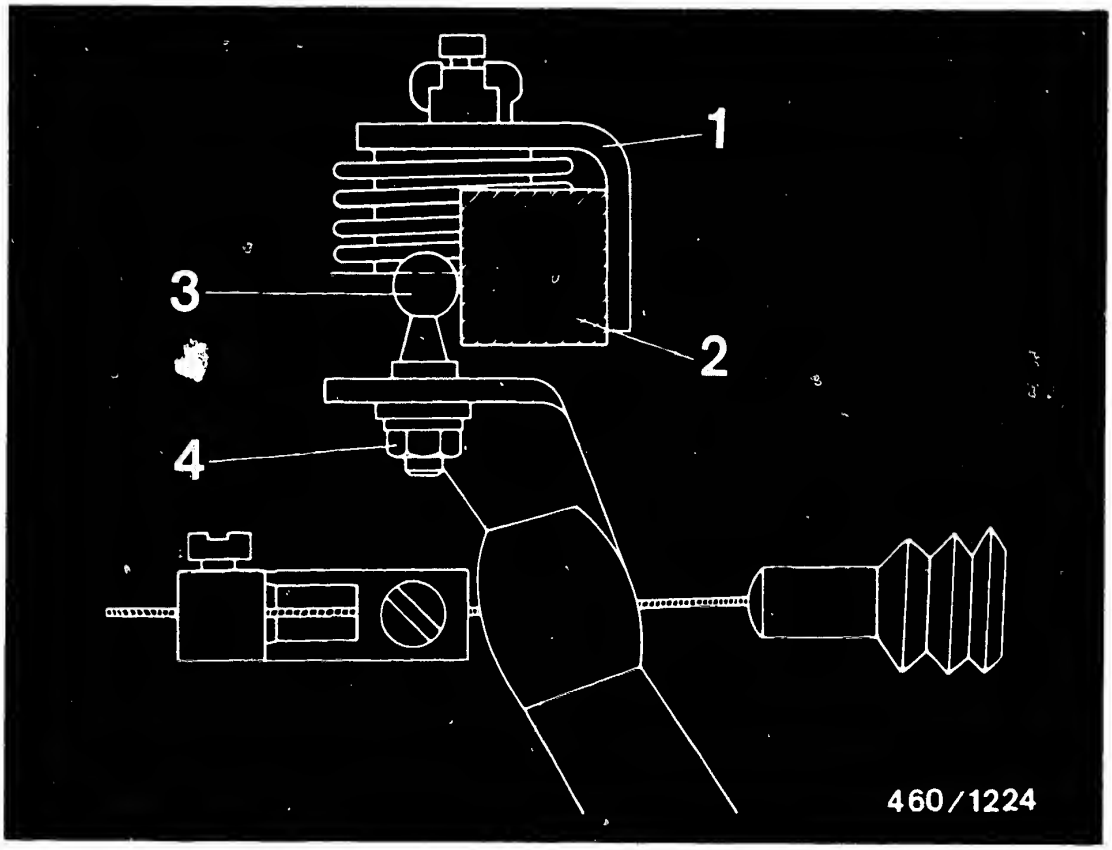
Operate the starting motor until the engine starts.



33.2 Adjust idle speed

Connect tachometer (e.g. photoelectric) to engine.
Adjust engine seed at idle-adjusting screw (see illustration, arrow) to: 800...860 min^{-1}
Engine XD 2S - 2.3 l with air conditioner 780...840 min^{-1}
Remember that engine camshaft and injection pump are driven at half the engine speed.
After adjusting, lock and seal adjusting screw.

Note:
Engine must be at normal operating temperature. Coolant temperature 80°C. Temperature-controlled idle increase must be off. Control lever up against idle-adjusting screw (see illustration, arrow).



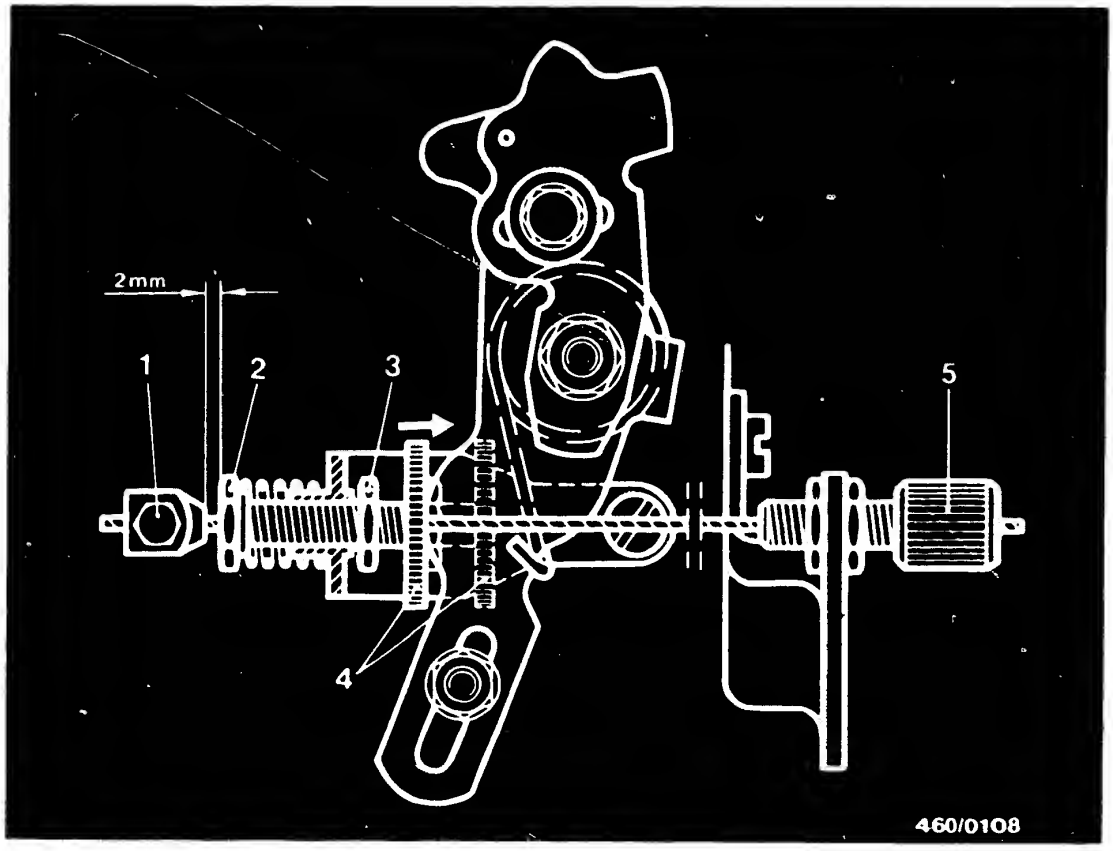
1 = Control lever
2 = Spacer (17 mm)
3 = Ball head
4 = Fastening nut

33.2.1 Adjust idle increase, engine XD 3T - 2.5 l

Requirements:
- "Warm" idle adjustment O.K.
- Coolant temperature 80°C
- Control lever up against idle-adjusting screw.

Adjusting:
Loosen fastening nut. Insert spacer (17 mm) between ball head and control lever. Press ball stud against spacer and tighten.
Engine speed must be 1050 ... 1150 min^{-1}.

Note:
It is also possible, for example, to use a screw with 17 mm hexagon head as a spacer.



1 = Clamping piece
2 = Hexagon nut
3 = Lock nut
4 = Knurled screw (large)
5 = Knurled screw (small)

33.2.2 Adjust idle increase, engine XD 2S - 2.3 l

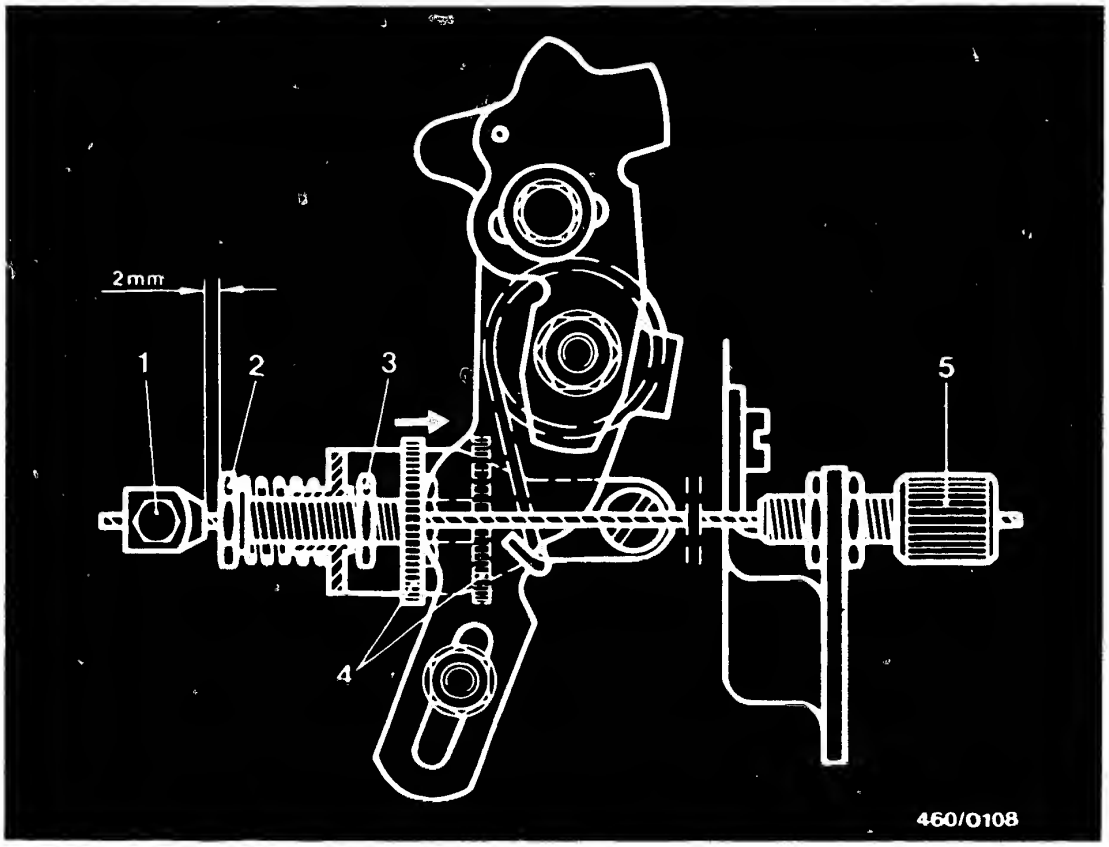
When the idle increase is switched off, there must be a 2 mm gap between the clamping piece and the hex nut.

Make corrections at the clamping piece.

Start the engine and warm it up until the cooling fan starts.

Activate the idle increase.

The engine speed must be 1100 ... 1200 min^{-1}.



1 = Clamping piece
2 = Hexagon nut
3 = Lock nut
4 = Knurled screw (large)
5 = Knurled screw (small)

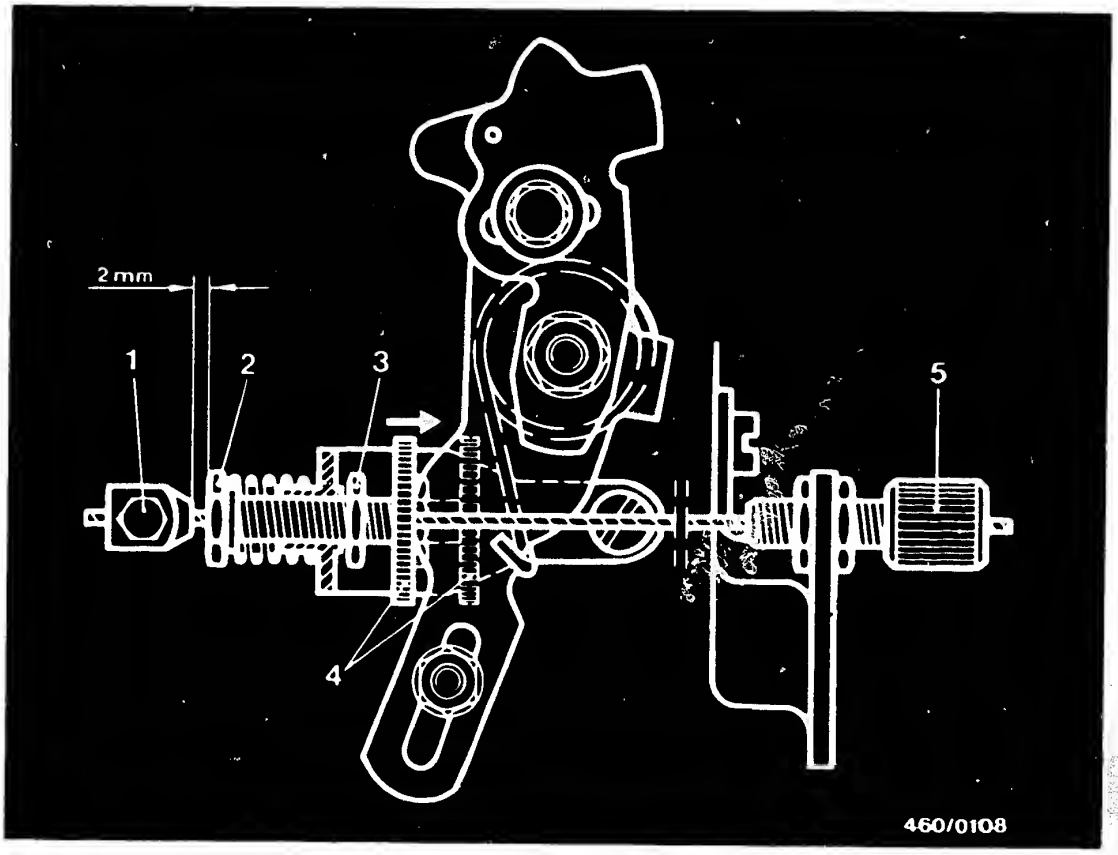
If correction is required, release the locking nut.

Hold the hex nut with a wrench, and adjust the knurled screw (large) until the correct engine speed (1100 ... 1200 min^{-1}) is attained.

Tighten the locking nut. To do so, hold the knurled screw (large) with a wrench.

Switch off the idle increase.

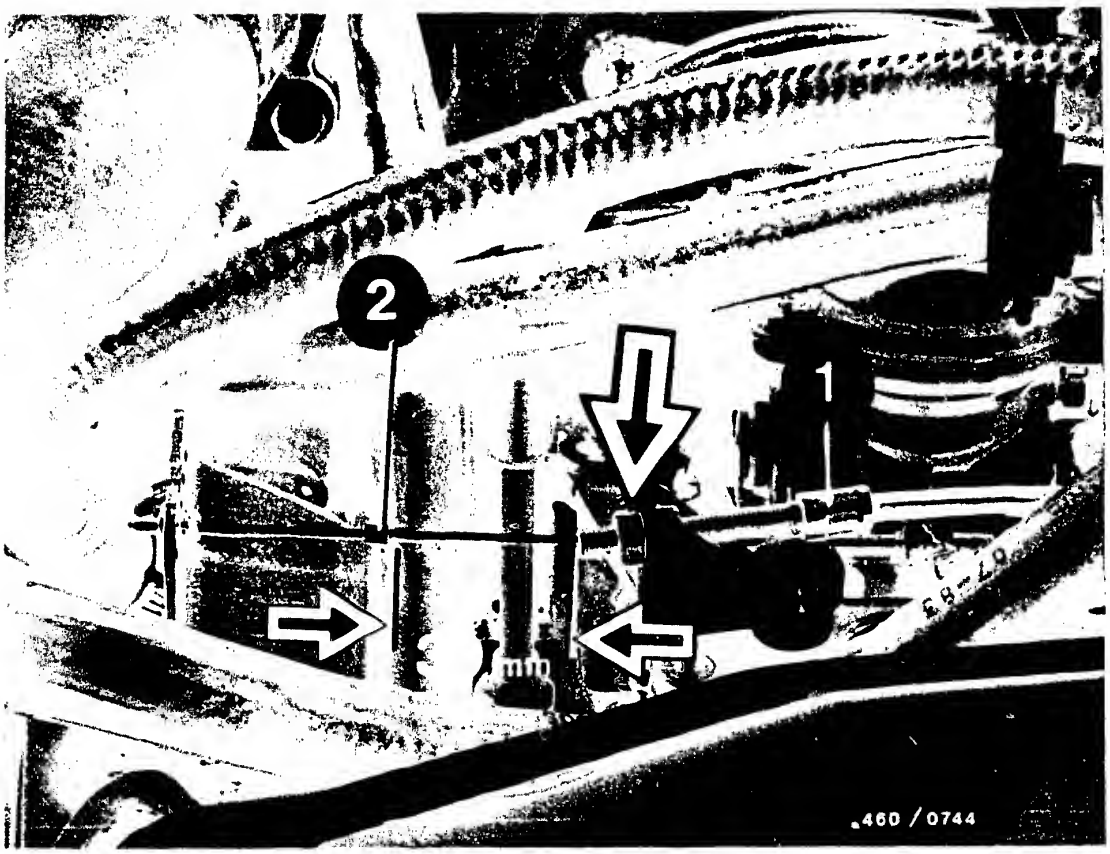
Release the locking nut for the knurled screw (small). Move the knurled screw (small) against the cable sleeve and tighten the locking nut.



1 = Clamping piece
2 = Hexagon nut
3 = Lock nut
4 = Knurled screw (large)
5 = Knurled screw (small)

Check the 2 mm gap between the clamping screw and the hex nut.

If need be, correct the gap using the clamping piece.



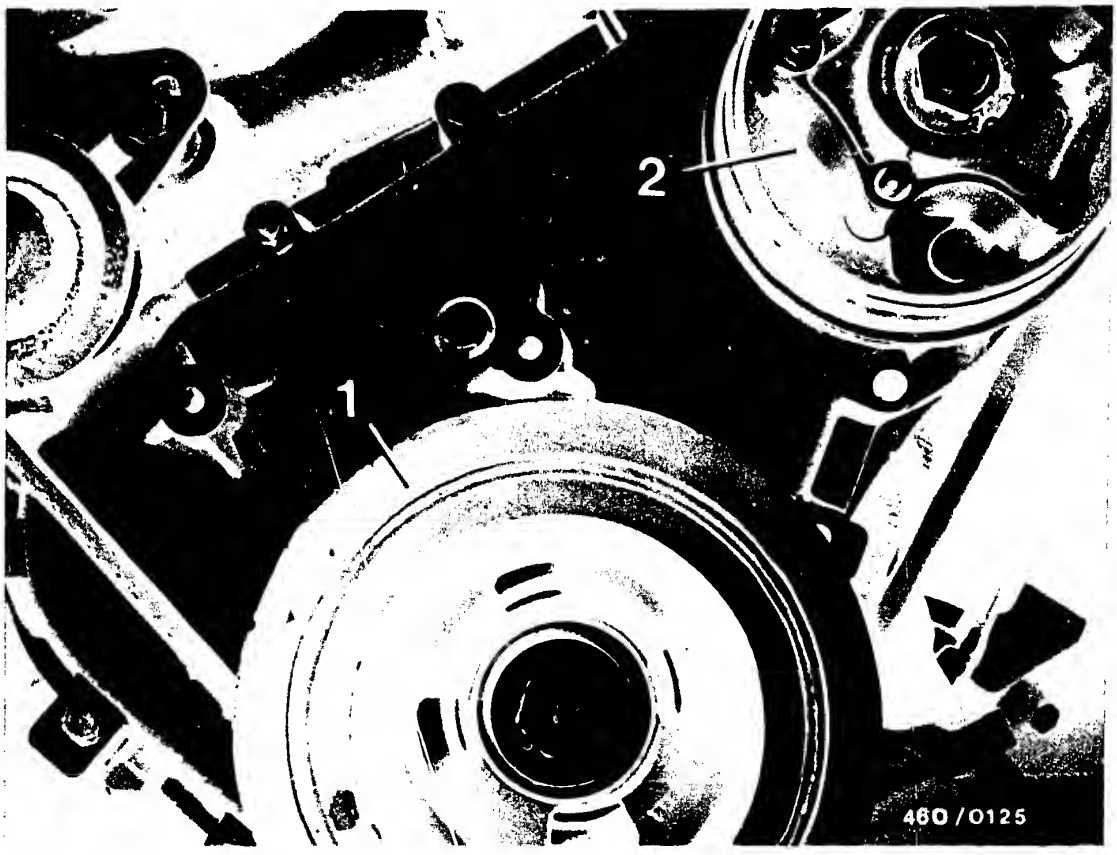
33.3 Kick-down adjustment

Prerequisite:

- Engine at normal operating temperature, temperature of cooling water + 80°C.

Adjustment:

- Press the accelerator pedal down to the kick-down point.
- Release the locking nuts (arrow) and adjust the guide sleeve (1) to a distance of 39 mm from the cable clamp (2).
- Tighten the locking nuts, check the setting.



34. Check and adjust engine timing

34.1 Check engine timing

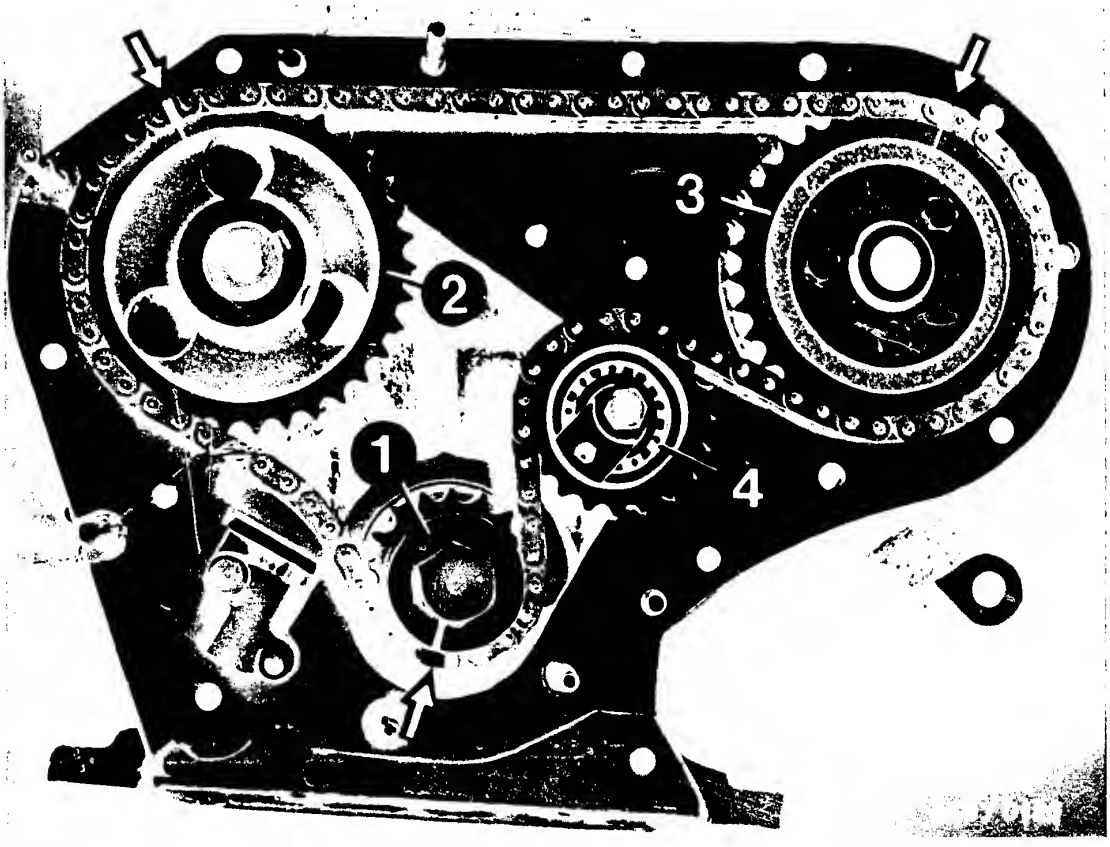
Take out the fan funnel and fan.

Take off the crankshaft wheel (1) and the fan wheel (2).

Remove the V-belt for the fan wheel and the crankshaft wheel.

Take off the cover for the timing chain.

Screw the fastening screw for the crankshaft wheel into the crankshaft gear.

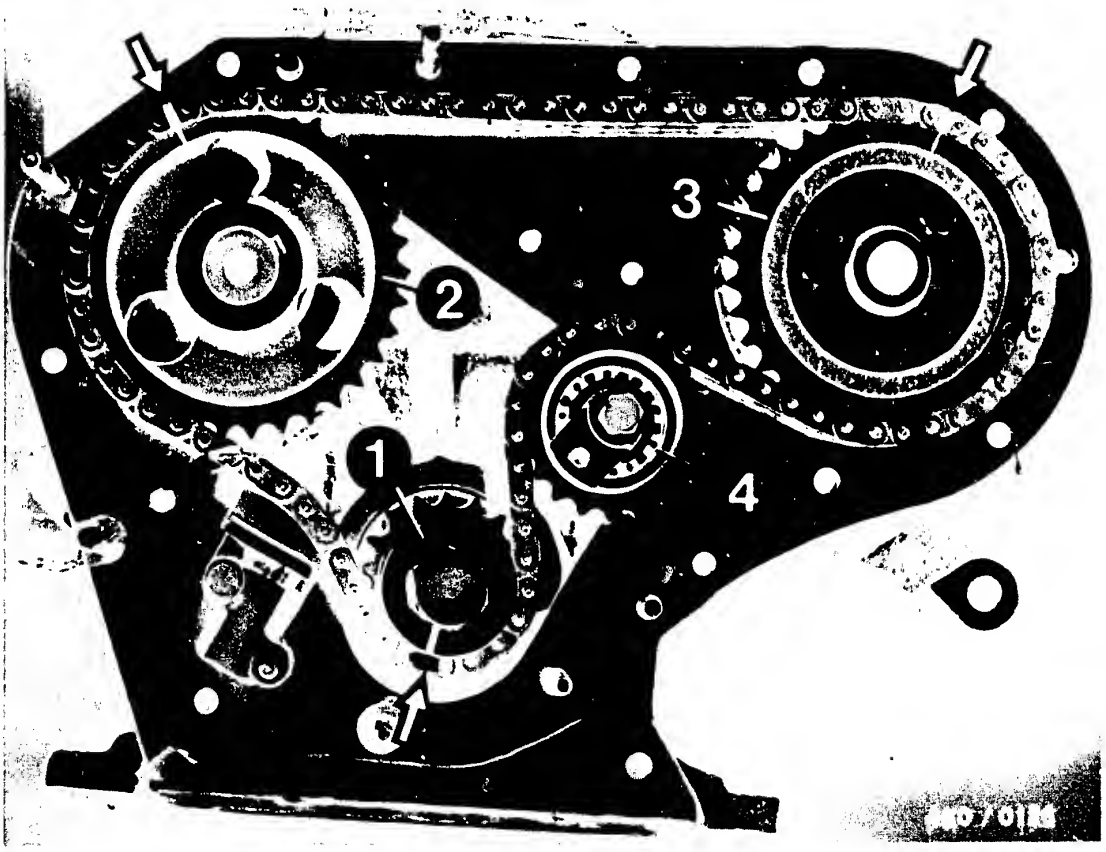


1 = Crankshaft gear
2 = Camshaft gear
3 = Injection-pump drive gear
4 = Intermediate gear

Turn the engine crankshaft in the direction of engine rotation using the crankshaft gear until the markings below line up:

- The marking on the crankshaft gear and the copper link in the chain (see illustration, arrow).
- Lines on the camshaft gear and chain (see illustration, arrow).
- Lines on the fuel-injection pump drive gear and chain (see illustration, arrow).

If the markings do not line up, adjust the engine timing.



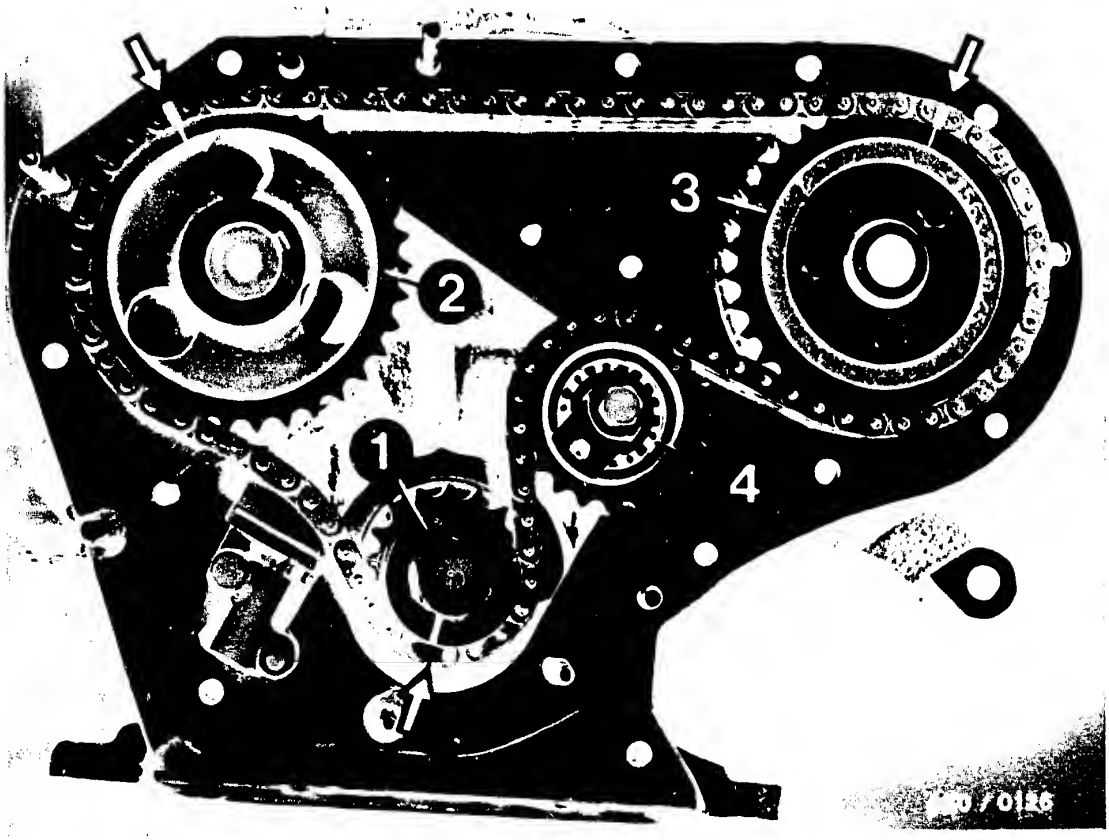
1 = Crankshaft gear
2 = Camshaft gear
3 = Injection-pump drive gear
4 = Intermediate gear

If the markings line up, remove the hex screw from the crankshaft gear.

Put on the cover for the timing chain.

Put in the crankshaft gear, the fan gear, and the V-belt.

Fasten the fan, and put in the fan funnel.



1 = Crankshaft gear
2 = Camshaft gear
3 = Injection-pump drive gear
4 = Intermediate gear

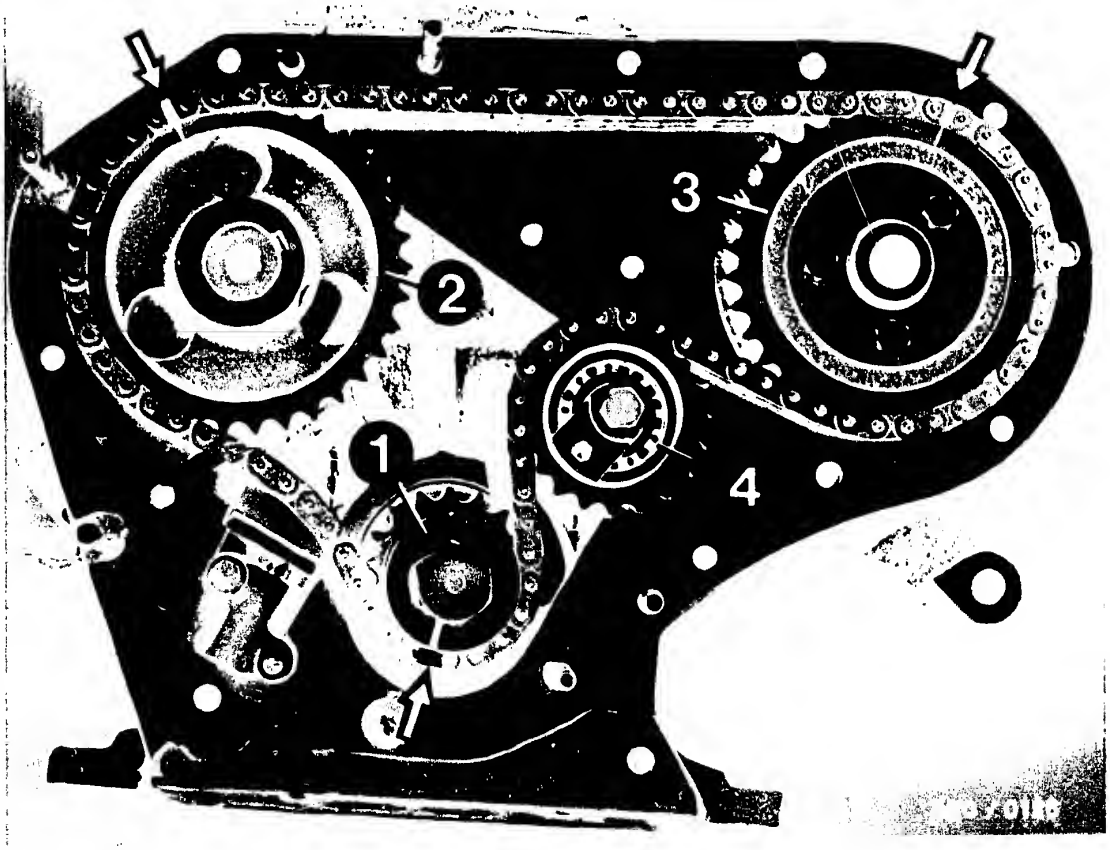
34.2 Adjusting engine timing

Using a 3-mm hex-socket wrench, release the chain tensioner. To do this, remove the plug.

Release the fastening screw for the intermediate gear and swing the eccentric to the right until the timing chain has been released.

Take off the timing chain.

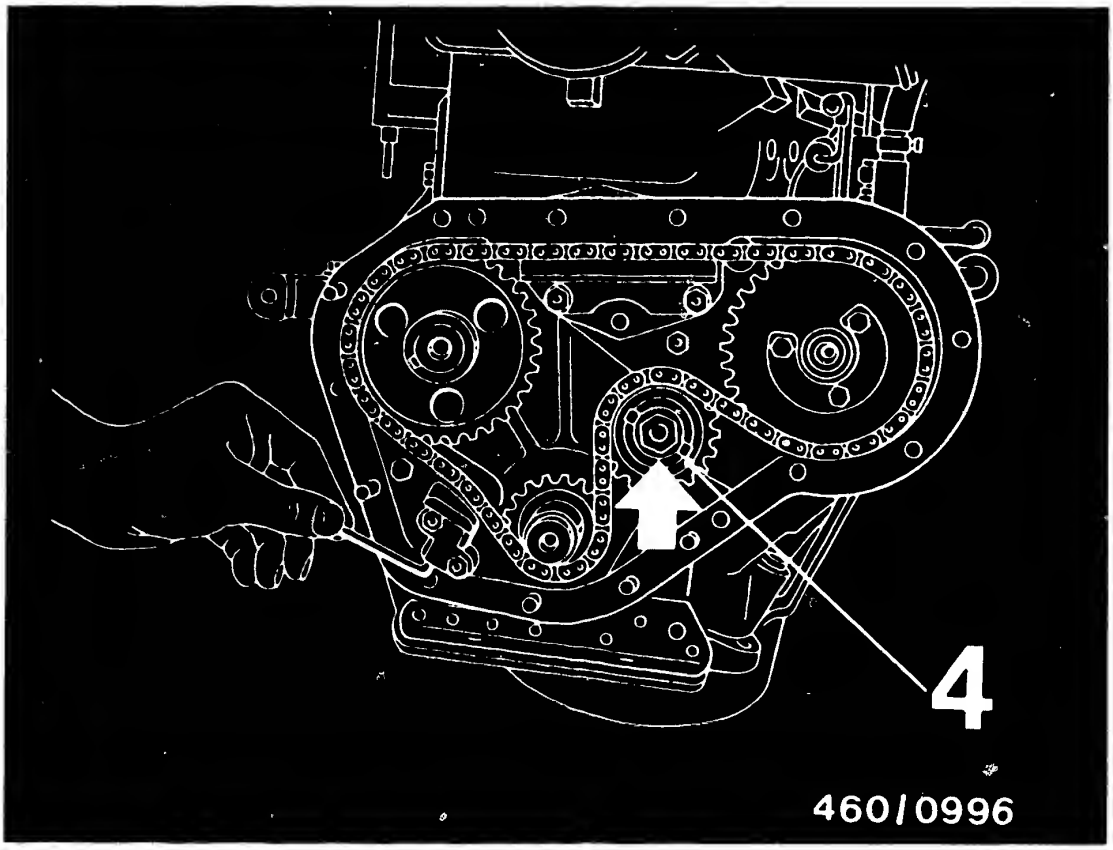
Bring the crankshaft gear, the camshaft gear, and the fuel-injection pump gear into position with the markings (arrows, see the Figure).



1 = Crankshaft gear
2 = Camshaft gear
3 = Injection-pump drive gear
4 = Intermediate gear

Set the timing chain on the crankshaft gear in such a way that the copper link is located at the prickpunch marking (see illustration, arrow).

When laying the timing chain on the other gear wheels, make certain that the line marking on the timing chain and that on the gear line up (see illustration, arrows).

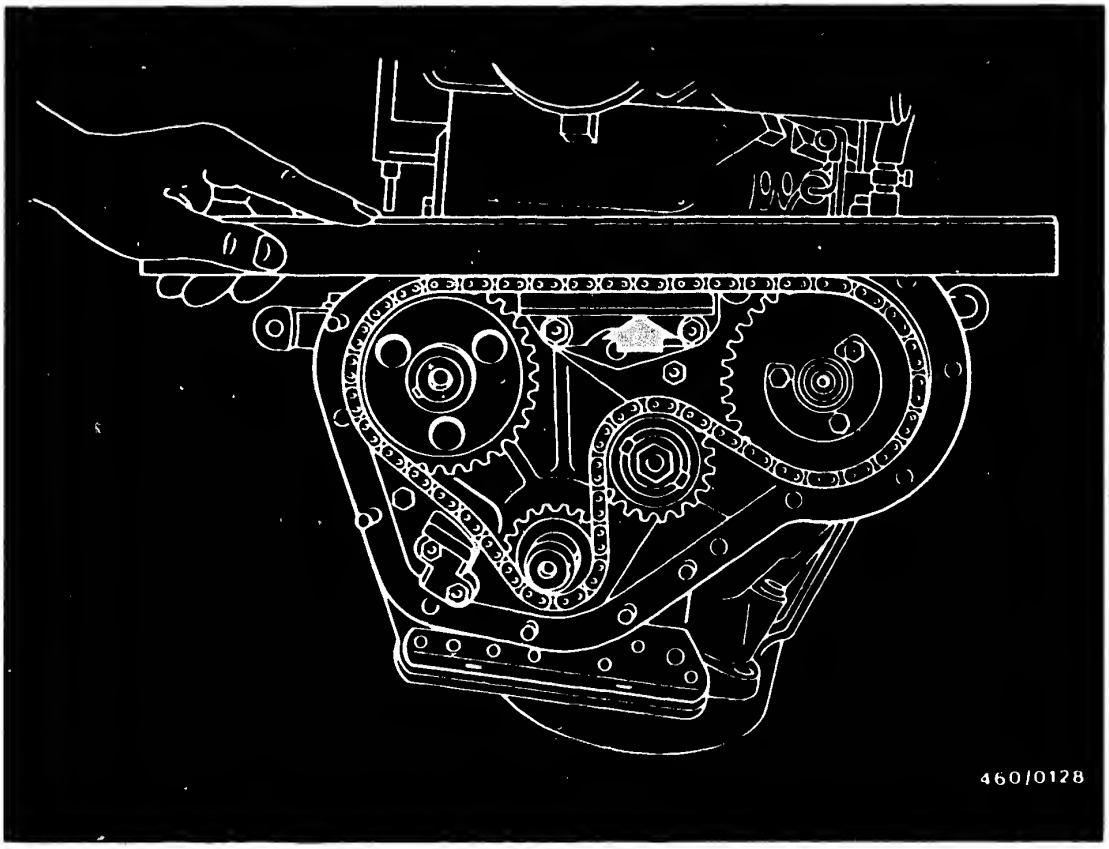


Swing the intermediate gear (4) to the left counter to the direction of engine rotation until a gap of 1.0 ... 2.0 mm is obtained between the guide shoe for the chain tensioner and its support.

Tighten the fastening screw for the intermediate gear (arrow) to 50 Nm.

Prestress the spring of the chain tensioner using a hex-socket-screw key until the timing chain lies up against the guide shoe with no clearance.

Put the screw plug into the chain tensioner.



Lay a straightedge across the camshaft gear and the pump gear.

Put the guide shoe (arrow) against the timing chain and tighten the fastening screws.

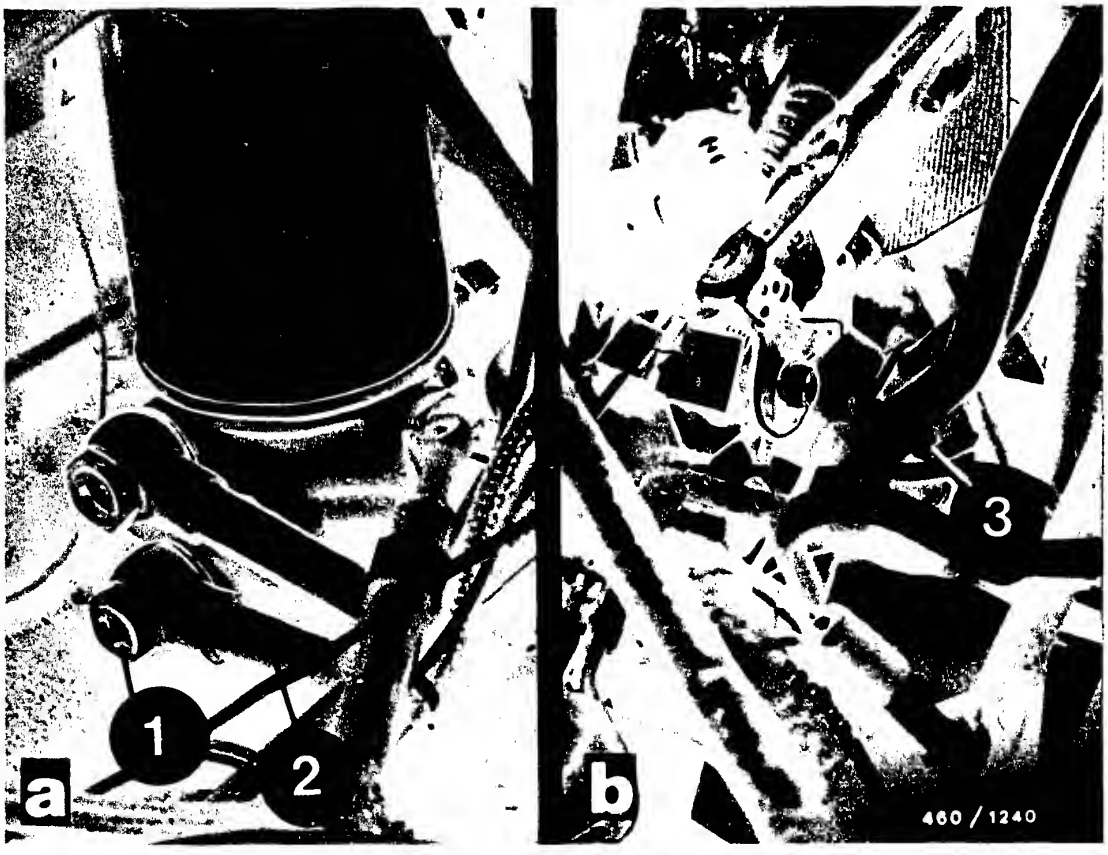
If the hex screw is still there, remove it from the crankshaft gear.

Put on the cover for the timing chain.

Put in the crankshaft gear, the fan gear, and the V-belt.

Note:

More recent models of the engine have no guide shoe (arrow).

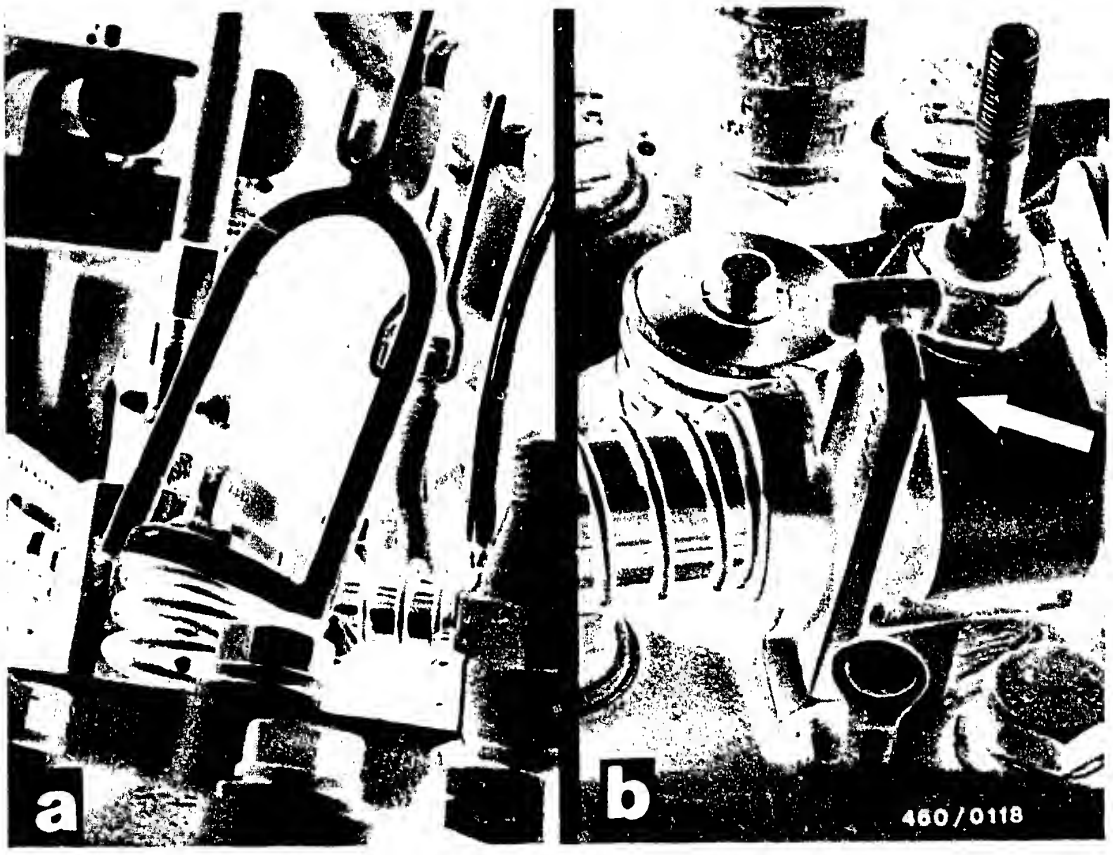


1 = Lower fastening screw
2 = Line
3 = Fastening clamp

Remove cylinder head cover.

Unscrew lower fastening screw on oil filter.

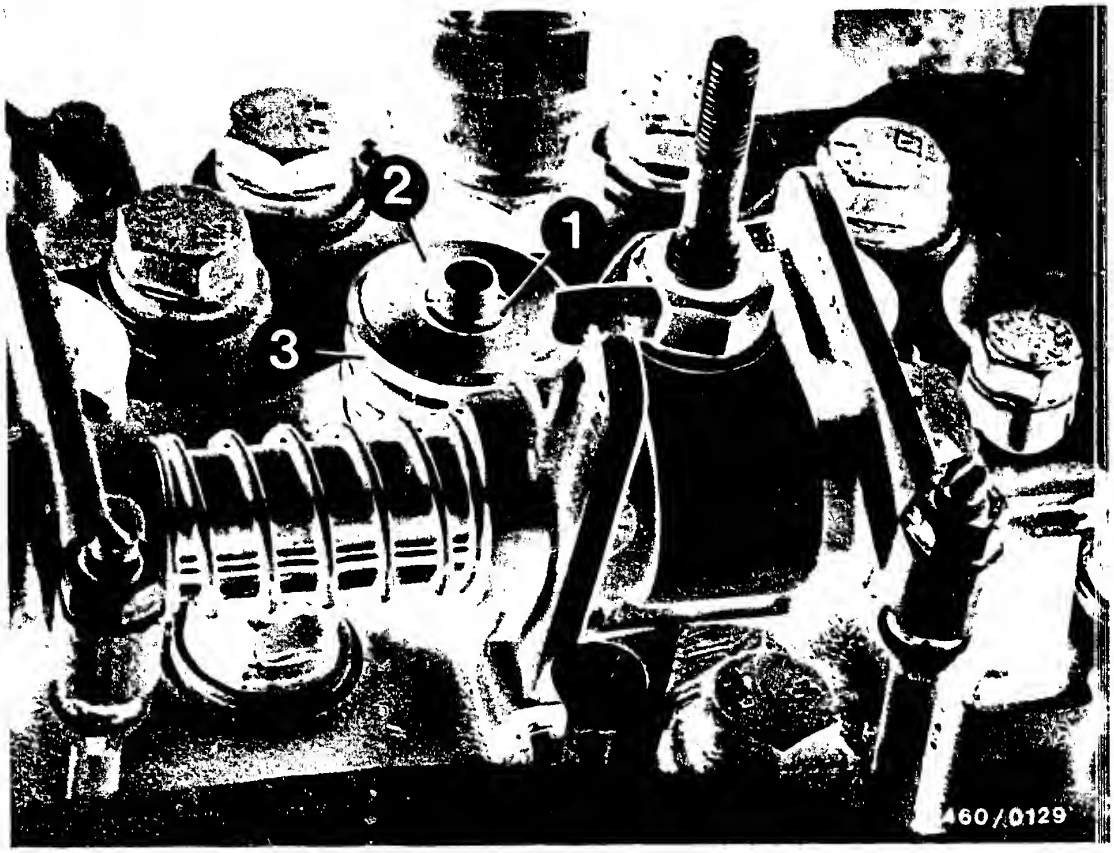
Loosen fastening clamp and lay line to one side.



Using a box wrench, turn the crankshaft in such a way that the exhaust of the 1st cylinder just opens with the piston at BDC.

Insert tool 8.0105 Y into the rocker arm shaft and press the spring of the 4th cylinder exhaust valve down (Figure, a).

In so doing, shove the rocker arm against the pressure spring on the rocker arm shaft and set it up in a vertical position. In that position, move the rocker arm to its initial location (Figure, b).

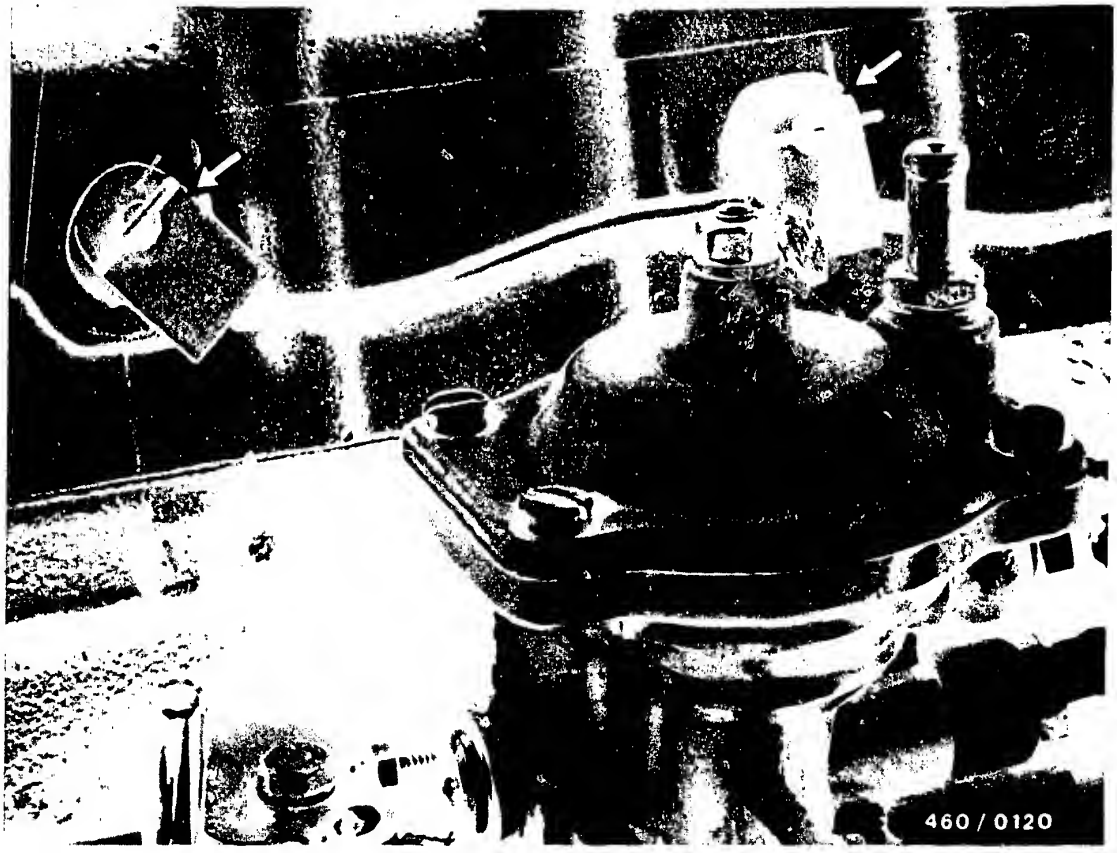


Turn the crankshaft in the direction of engine rotation until the 4th cylinder is at TDC.

When this is done, the valves of the 1st cylinder are at overlap.

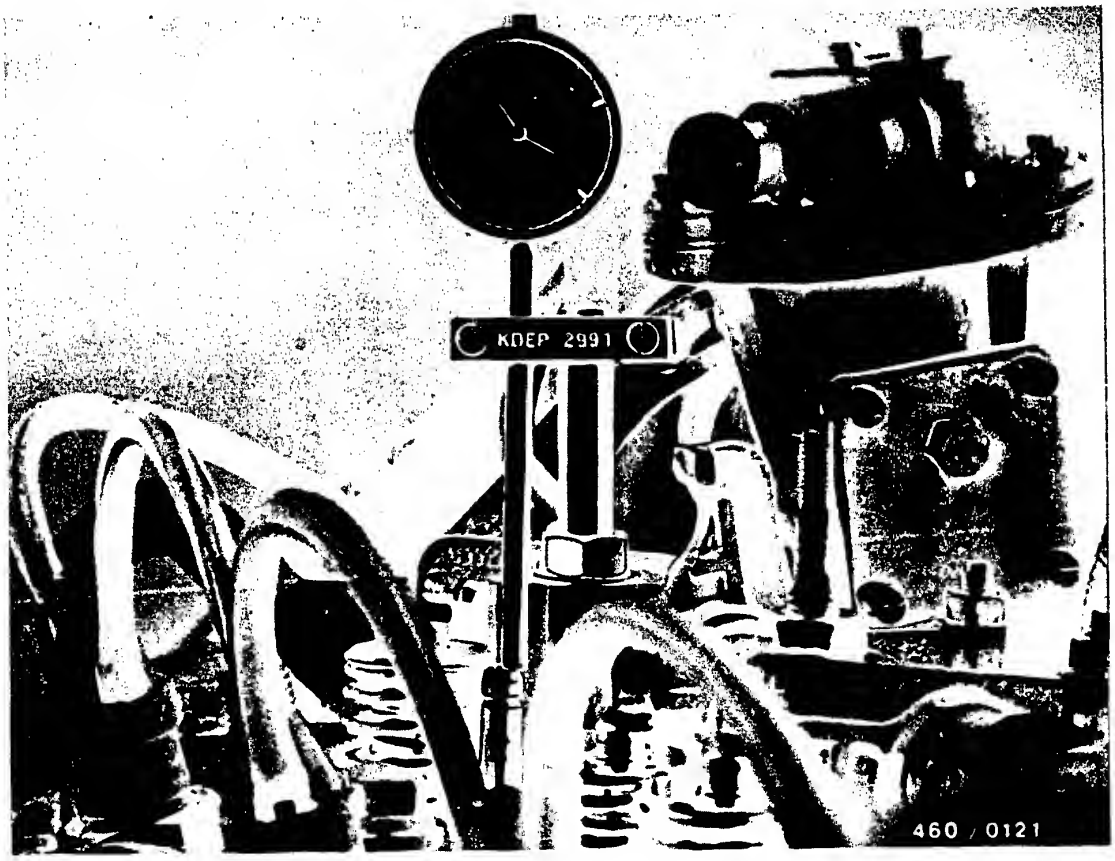
Press the valve spring of the 4th cylinder exhaust valve down using tool 8.0105 Y.
Remove the valve collets (1) from the exhaust valve.

Relax the valve spring, take the valve plate (2) and the valve spring (3) off the valve stem.



The 4th cylinder exhaust valve now lies on the engine piston.

Take out the sheathed-element glow plugs for the 3rd and 4th cylinders (arrows).



Screw the measuring tool KDEP 2991 on the threaded bolt of the 4th cylinder.

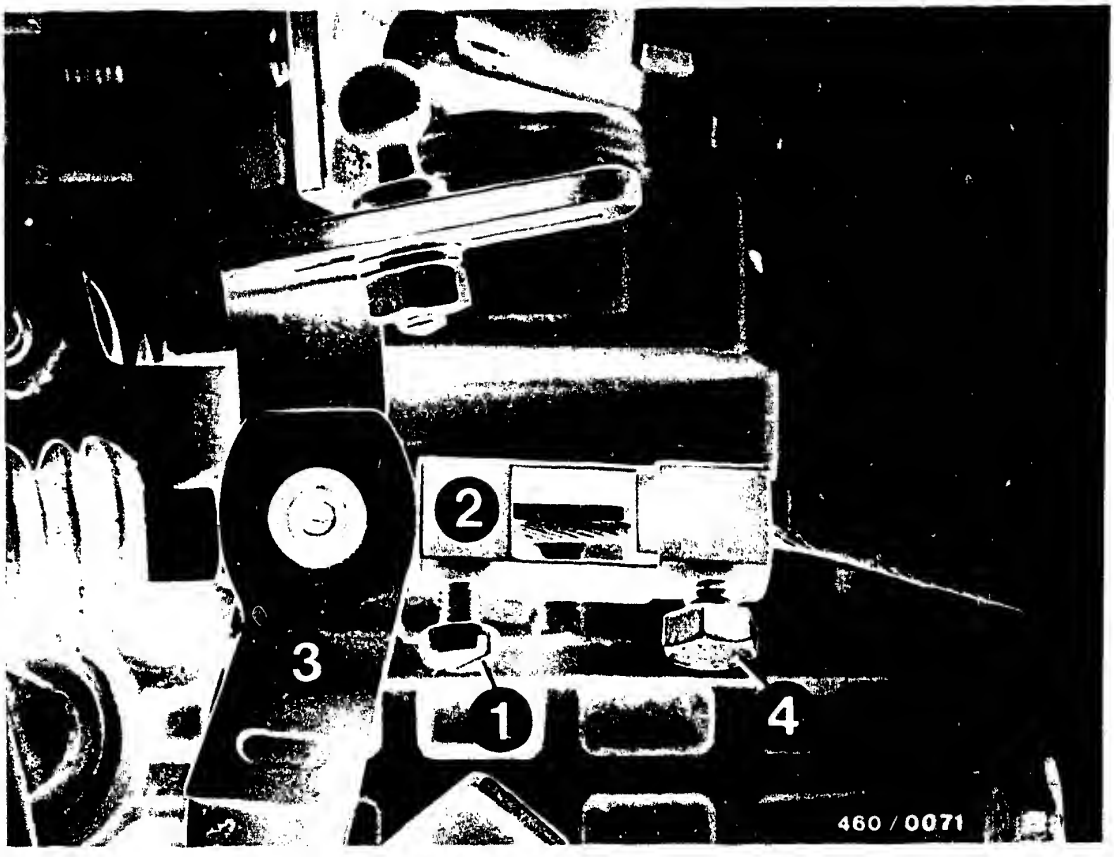
Clamp dial indicator 1 687 233 012 with the long measuring base into measuring tool KDEP 2991.

The measuring base lies on the 4th cylinder exhaust valve.

Prestress the dial indicator approx. 10 mm.

Turn the crankshaft counter to the direction of engine rotation until the plunger has made a stroke of approx. 7 mm.

Turn the crankshaft back in the direction of engine rotation to the TDC position of the 4th cylinder. Set the dial indicator at "0".



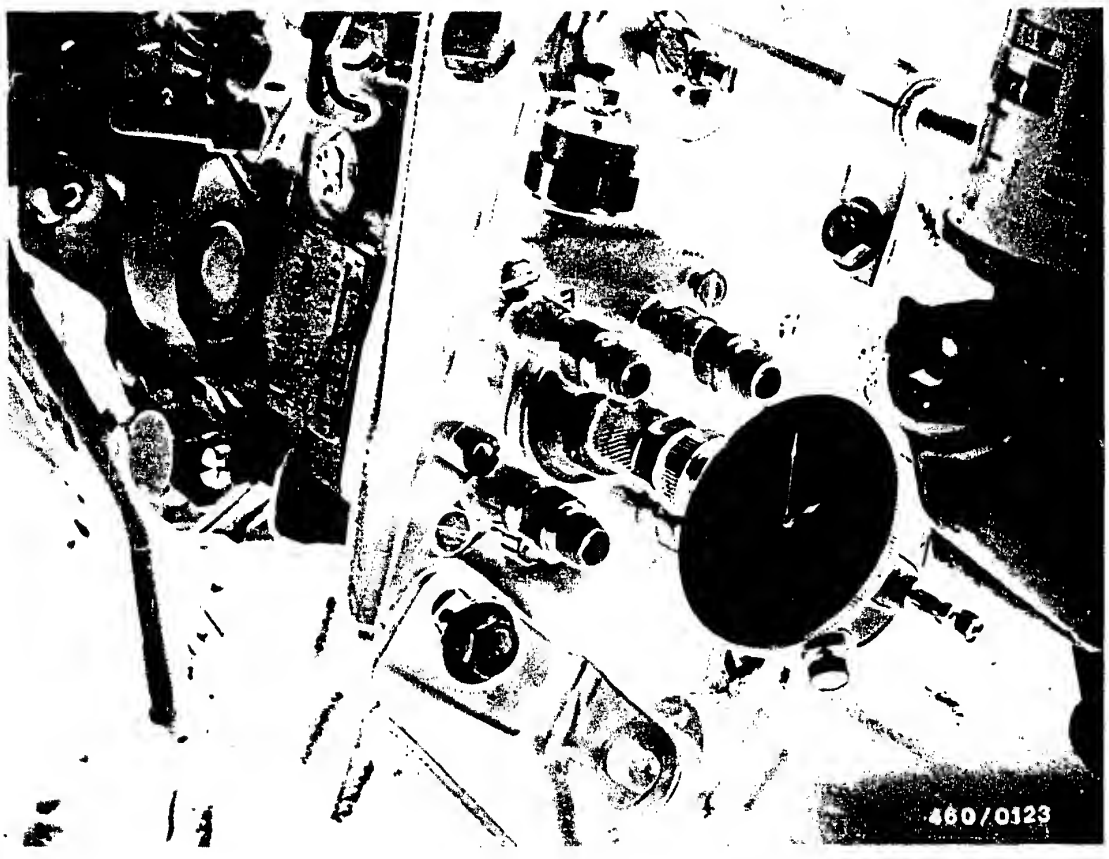
XD 3 T - 2.5 l engine only

To test and adjust the start of fuel delivery, the temperature-controlled cold-start accelerator (KSB) must be in its zero position.

For this, release the clamping screw (1) on the fuel-injection pump. Pull the spacer piece (2) and the control lever (3) toward the hydraulic head.

Turn the spacer piece (2) by 90° and shove it back toward the drive shaft until the control lever (3) touches up against the stop bracket.
In this position, the control device is switched off.

Note:
Do not release the locking screw (4) or a readjustment of the control device will be necessary.



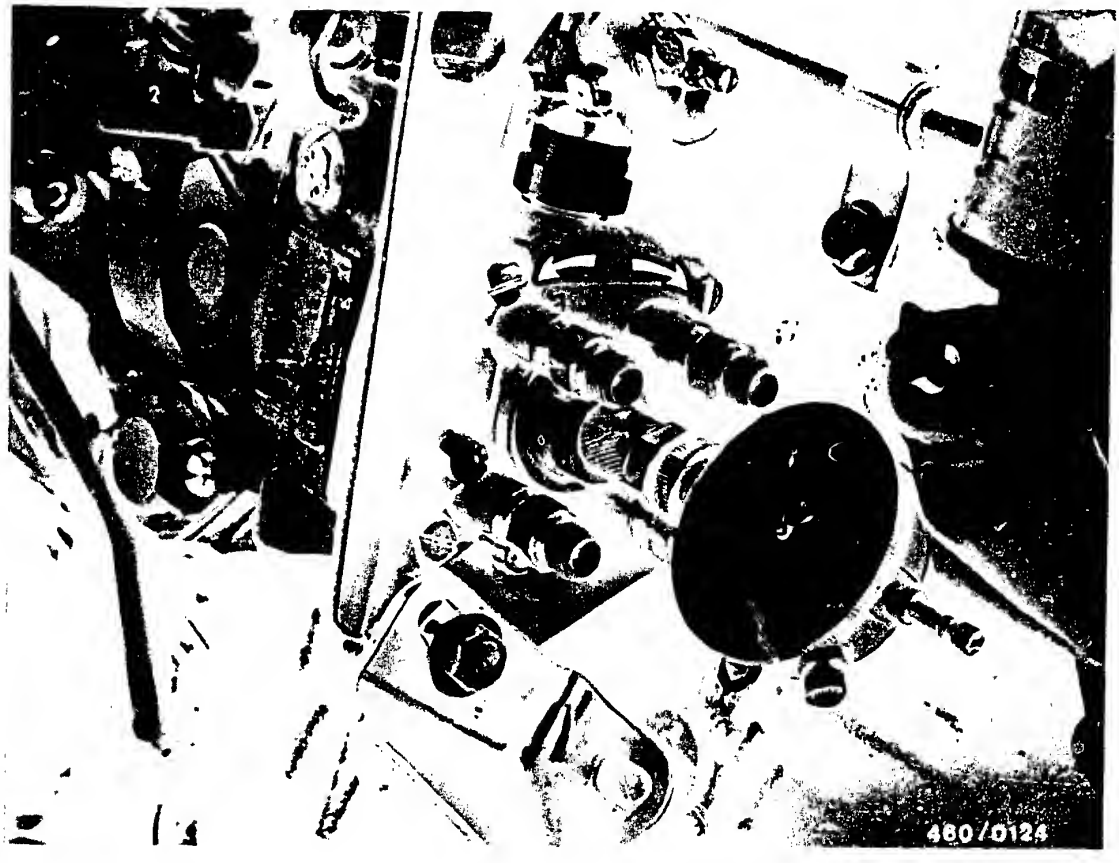
Remove the fuel-injection lines. (Prevent the delivery valve holders from becoming loose by holding them with a wrench).

Remove the bleeder screw from the central screw plug (triangular screw) of the fuel-injection pump.

Screw measuring tool KDEP 1085 into the hole for the bleeder screw.

Put on dial indicator 1 687 233 011 or .. 012 with the measuring base, and prestress it approx. 3 mm.

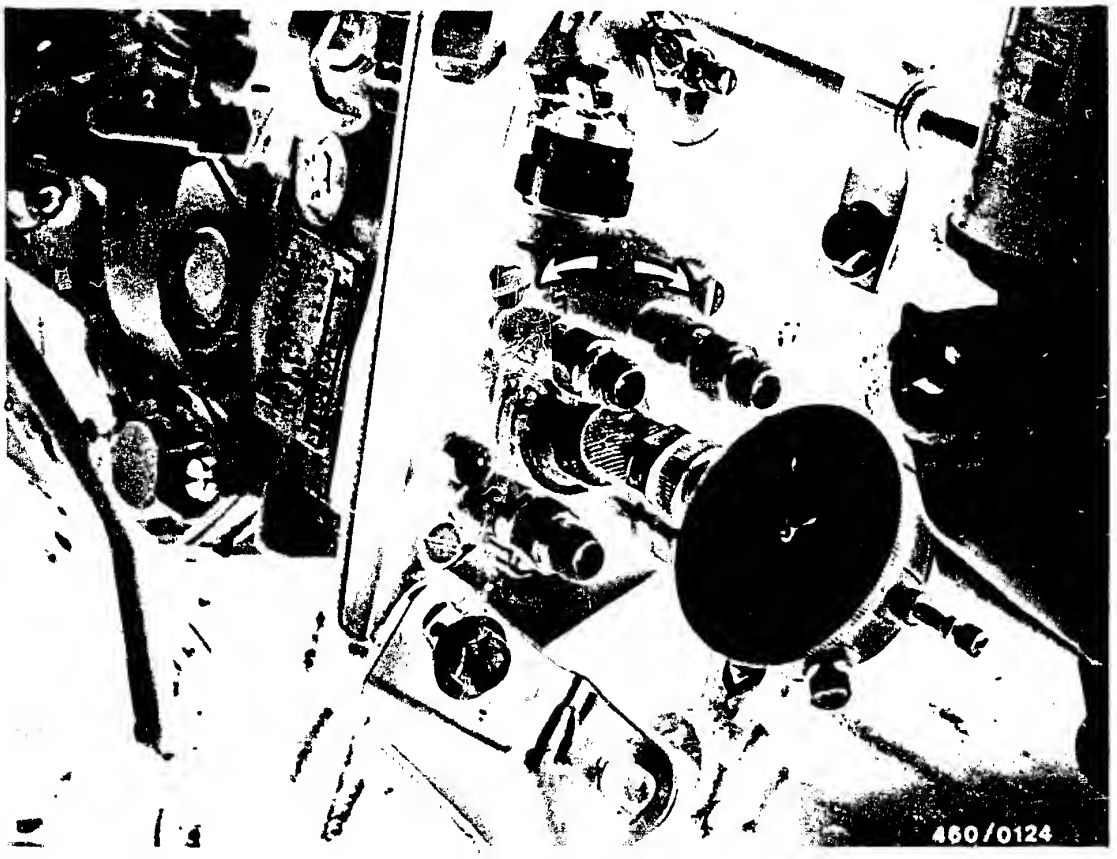
Turn the crankshaft counter to the direction of engine rotation until the dial indicator indicates the BDC of the fuel-injection pump plunger. Set the dial indicator at "0".



Turn the crankshaft in the direction of engine rotation until the dial indicator on the exhaust valve of the 4th cylinder indicates a piston stroke of

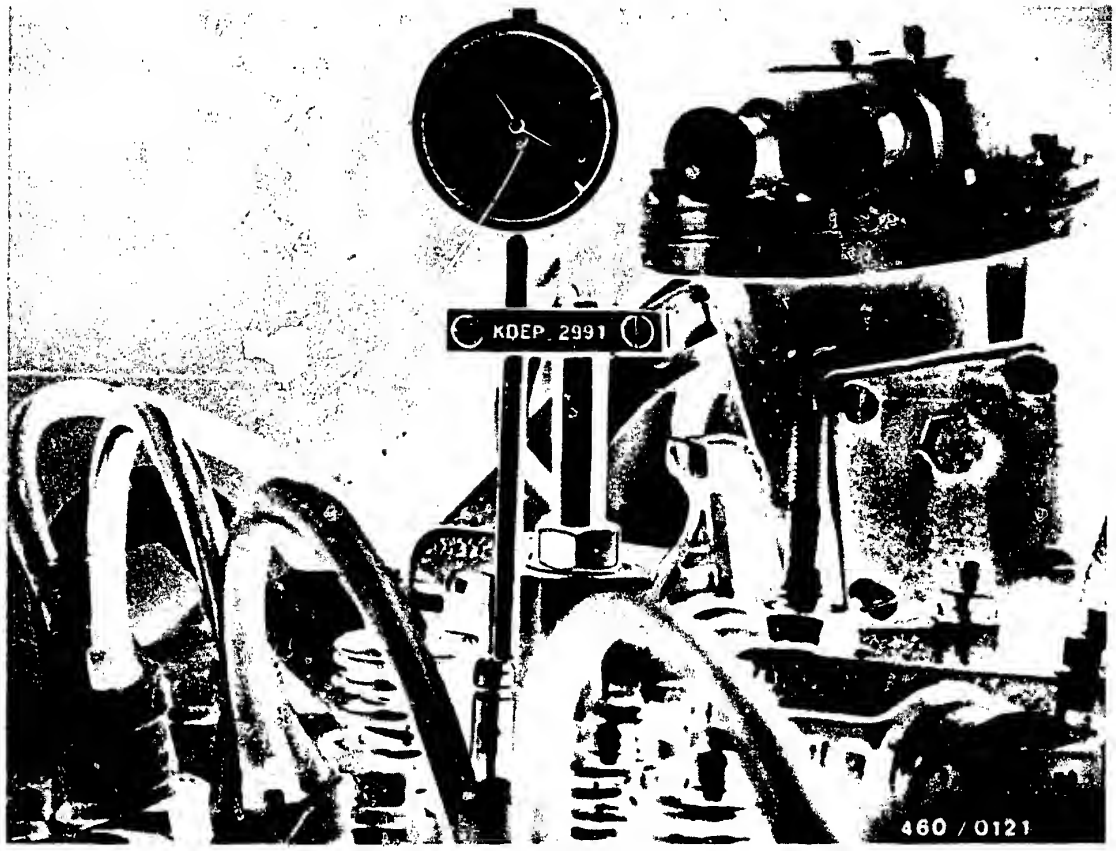
505/604 D-Turbo Engine XD 2S - 2.3 l Automatic	0.51 mm
505/604 D-Turbo Engine XD 3T - 2.5 l	0.89 mm
505/604 D-Turbo Engine XD 3T - 2.5 l Automatic	0.57 mm

before TDC.



With the piston settings as indicated, the dial indicator on the fuel-injection pump must indicate a pump plunger stroke of 0.48...0.52 mm ABDC.

If need be, adjust the stroke by pivoting fuel-injection pump. To do this, the fastening screws on the fuel-injection must be released.
(Loosen injection-pump fastening screws also on support bracket.)
Then retighten the fastening screws to 20 Nm.

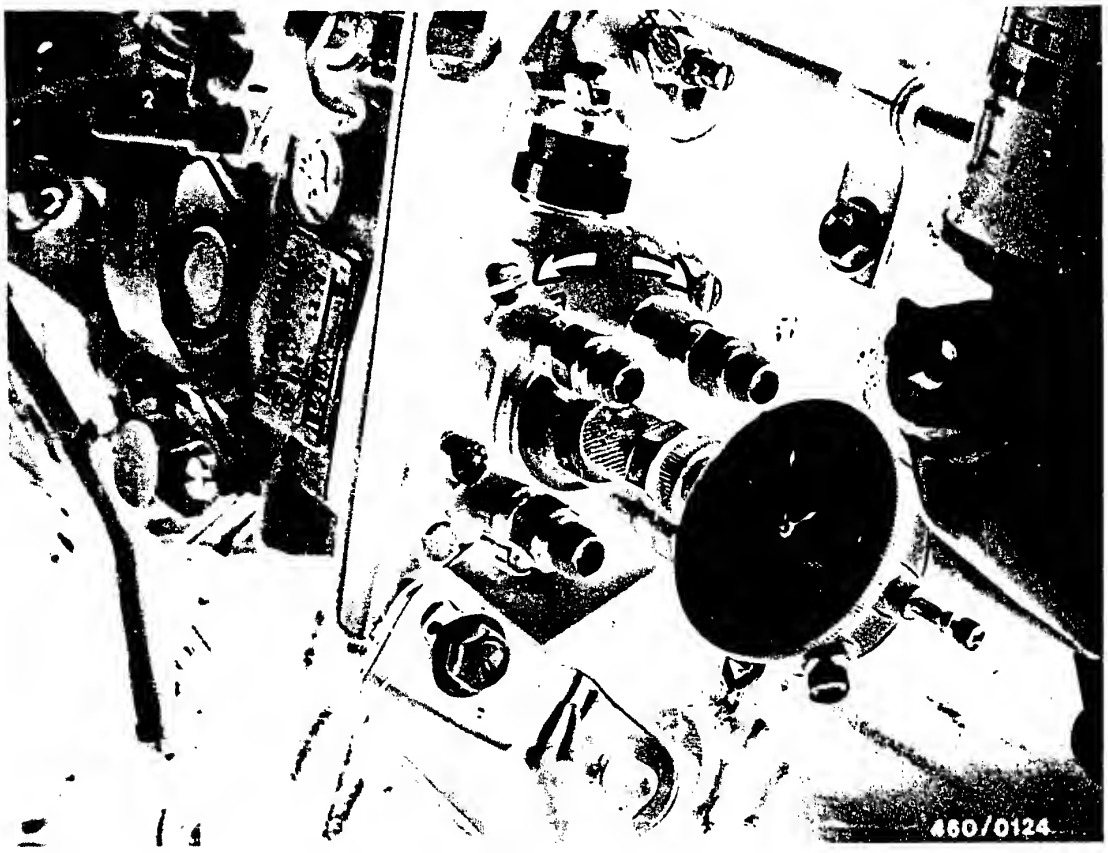


Checking adjustment of the fuel-injection pump to the engine

Turn the engine crankshaft in the direction of engine rotation as far as the TDC position for the 4th cylinder.

Check the 0 position of the dial gauge on the indicator exhaust valve.

Turn the crankshaft counter to the direction of engine rotation until the dial indicator shows the stroke of approx. 7 mm (7 turns of the needle).

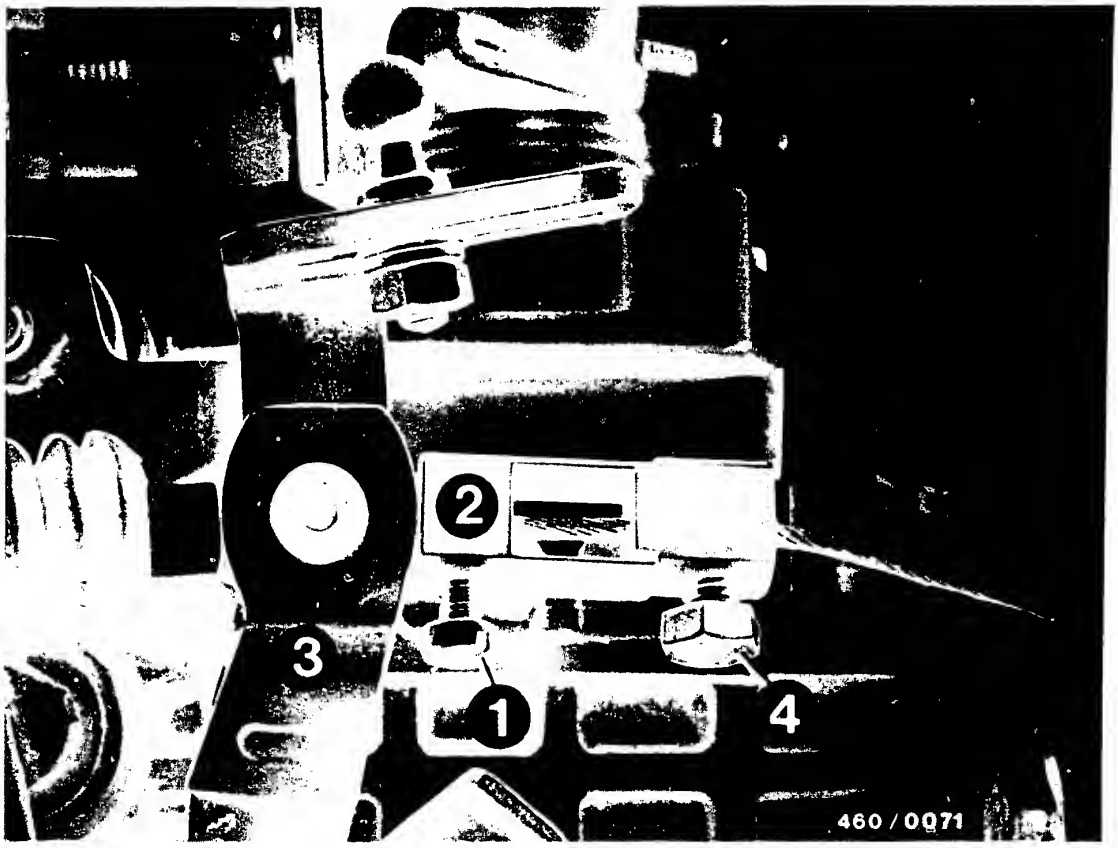


Turn the crankshaft in the direction of engine rotation until the dial indicator on the fuel-injection pump shows a stroke of 0.50 mm.

In this setting, the piston of the 4th cylinder must be

505/604 D-Turbo Engine XD 2S - 2.3 l Automatic	0.49...0.53 mm
505/604 D-Turbo Engine XD 3T - 2.5 l	0.87...0.91 mm
505/604 D-Turbo Engine XD 3T - 2.5 l Automatic	0.55...0.59 mm

before TDC.



XD 3 T - 2.5 l engine only

Pull the control lever (3) and the spacer piece (2) toward the hydraulic head.

Turn the spacer piece (2) by 90° and shove it back toward the drive shaft.

The spacer piece is now in its initial position.

Tighten the clamping screw (1).

Note:

Do not release the locking screw (4) or it will be necessary to readjust the control device.

Remove measuring tool KDEP 1085 and the dial indicator from the fuel-injection pump.

Put on the bleeder screw, using a new copper gasket ring.

Bring the engine piston of the 4th cylinder into the TDC position. Remove measuring tool KDEP 2991 and the dial indicator. Put the valve spring and the upper valve plate on the 4th cylinder exhaust valve.

Using tool 8.0105 Y, press the valve spring down.
While so doing, put in the exhaust valve collets.
Relax the valve spring.
Turn the crankshaft so that the 1st cylinder exhaust valve just opens with the piston at BDC.

Using the spring plate, press the valve spring of the 4th cylinder exhaust valve down.

Shove the rocker arm against the spring of the rocker arm shaft and put it in a horizontal position.

In that position, move the rocker arm on to the exhaust valve and tappet.

Remove tool 8.0105 Y.

Checking valve clearance

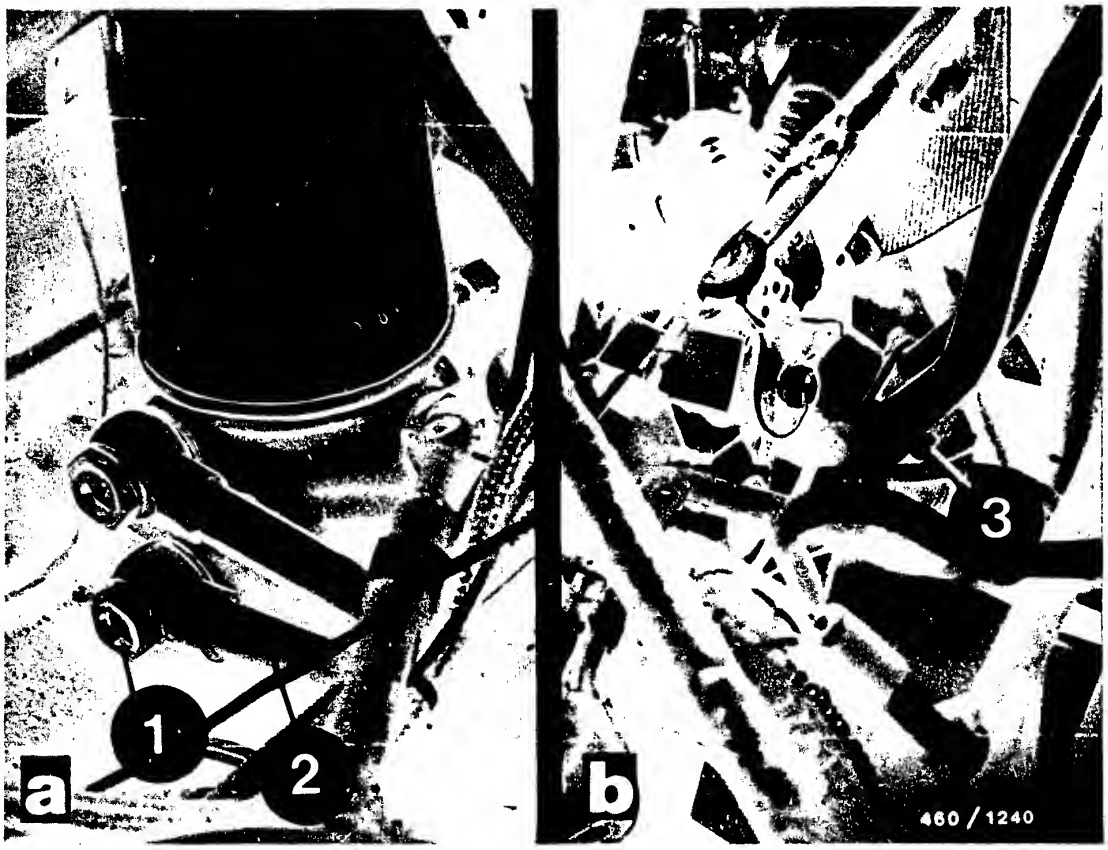
Check valve clearance only with engine cold (min. 6 hrs at rest).

Intake valve: 0.15 mm

Exhaust valve: 0.25 mm

Put on the cylinder head cover, the fan funnel, and the line from the oil cooler to the oil filter.

Put in the sheathed-element glow plugs for the 3rd and 4th cylinders. Put in the fuel-injection lines. (Prevent the delivery valve holders from turning by holding them with a wrench.) If need be, bleed the fuel-injection system.



1 = fastening screw
2 = line
3 = fastening clamp

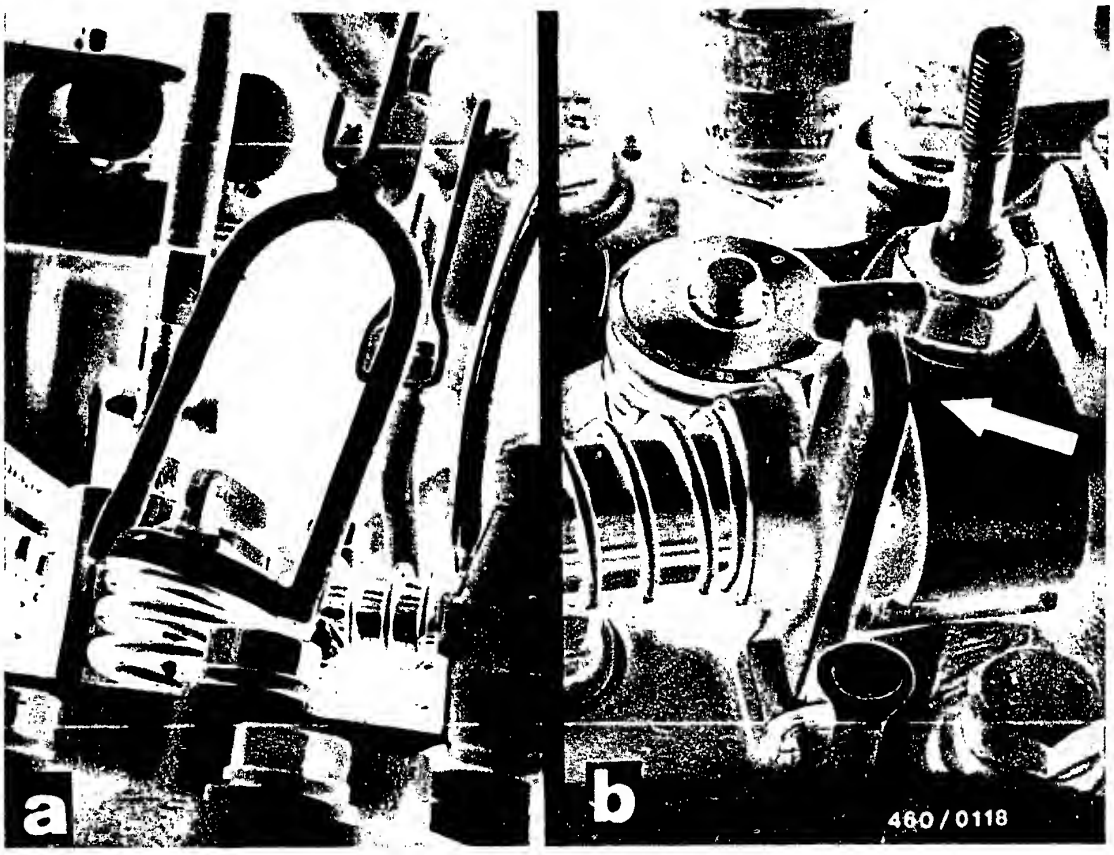
35. Coordination, injection-pumpe - engine (injection timing)

Remove the fan funnel.

Remove the cylinder head cover.

Unscrew lower fastening screw on oil filter.

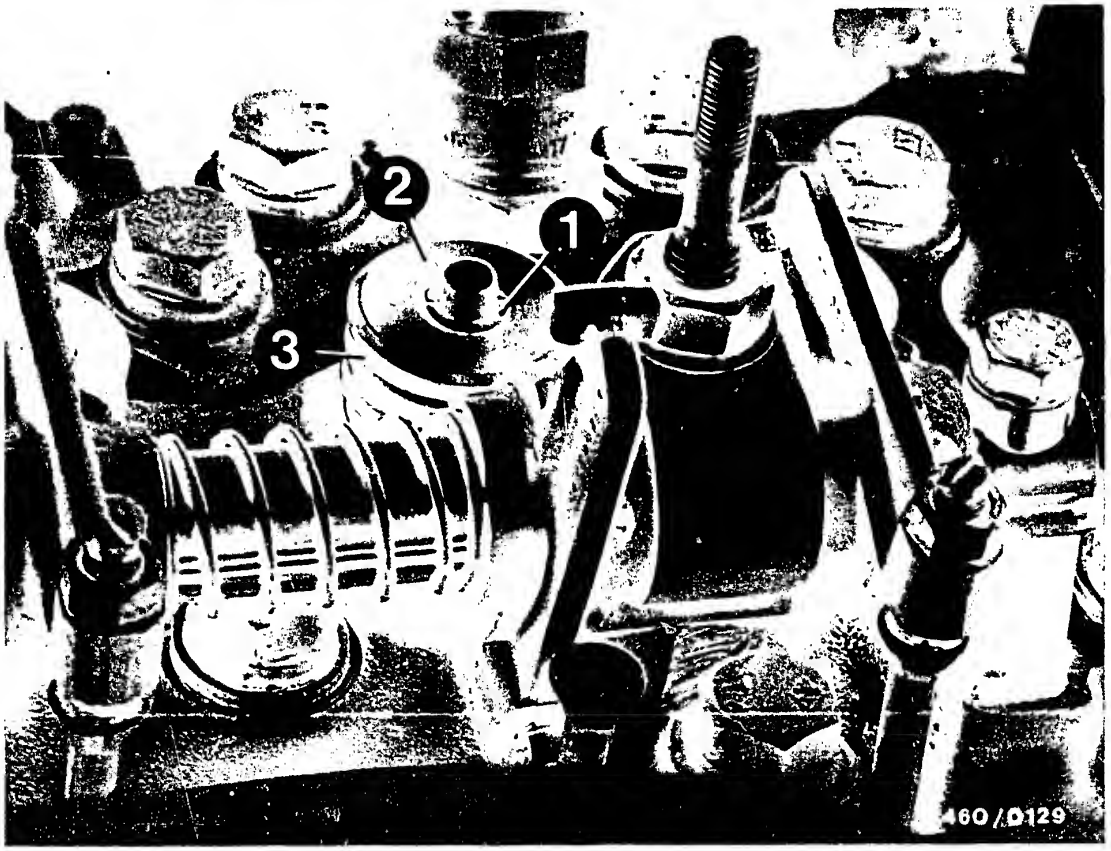
Loosen fastening clamp and lay line to one side.



Using a box wrench, turn the crankshaft so that the exhaust of the 1st cylinder just opens with the piston at BDC.

Insert tool 8.0105 Y into the rocker arm shaft and press the spring of the 4th cylinder exhaust valve down (Figure a).

Shove the rocker arm against the pressure spring on the rocker arm shaft and set it up in a vertical position. In that position, move the rocker arm to its initial location (Figure b).

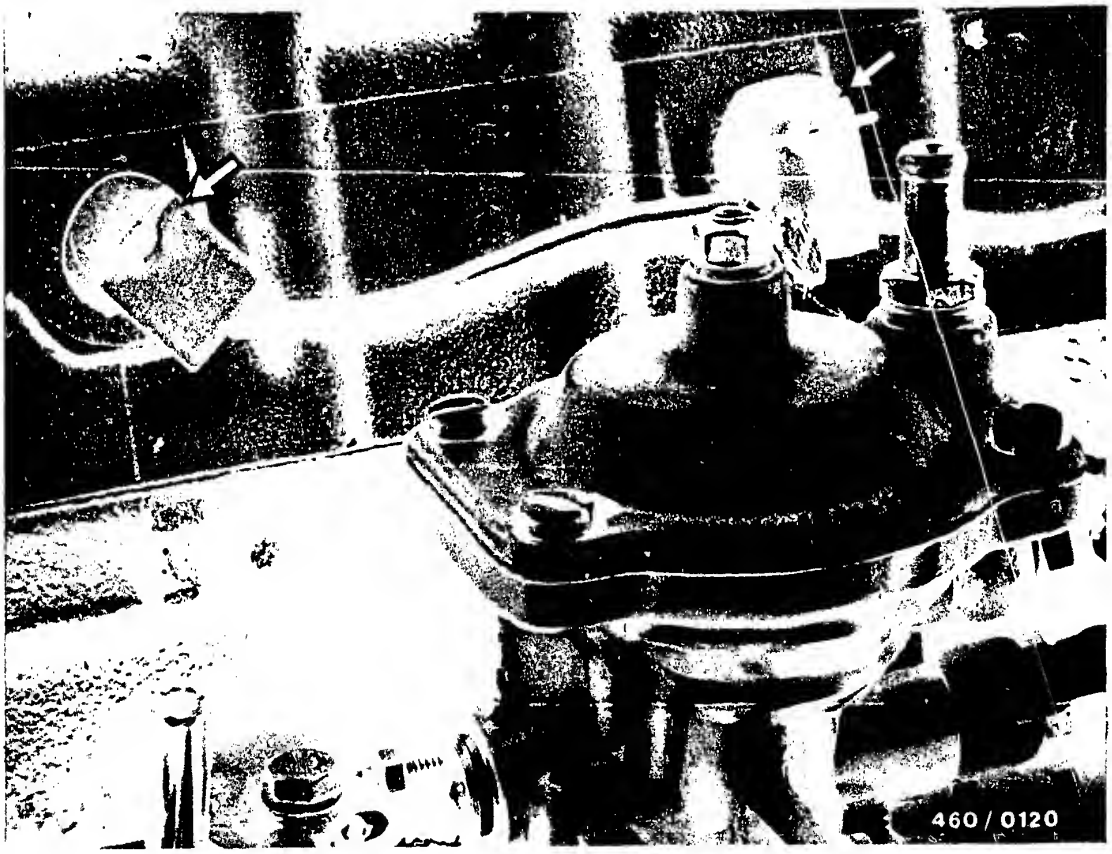


Turn the crankshaft in the direction of engine rotation until the 4th cylinder is at TDC.

The 1st cylinder valves are then at overlap.

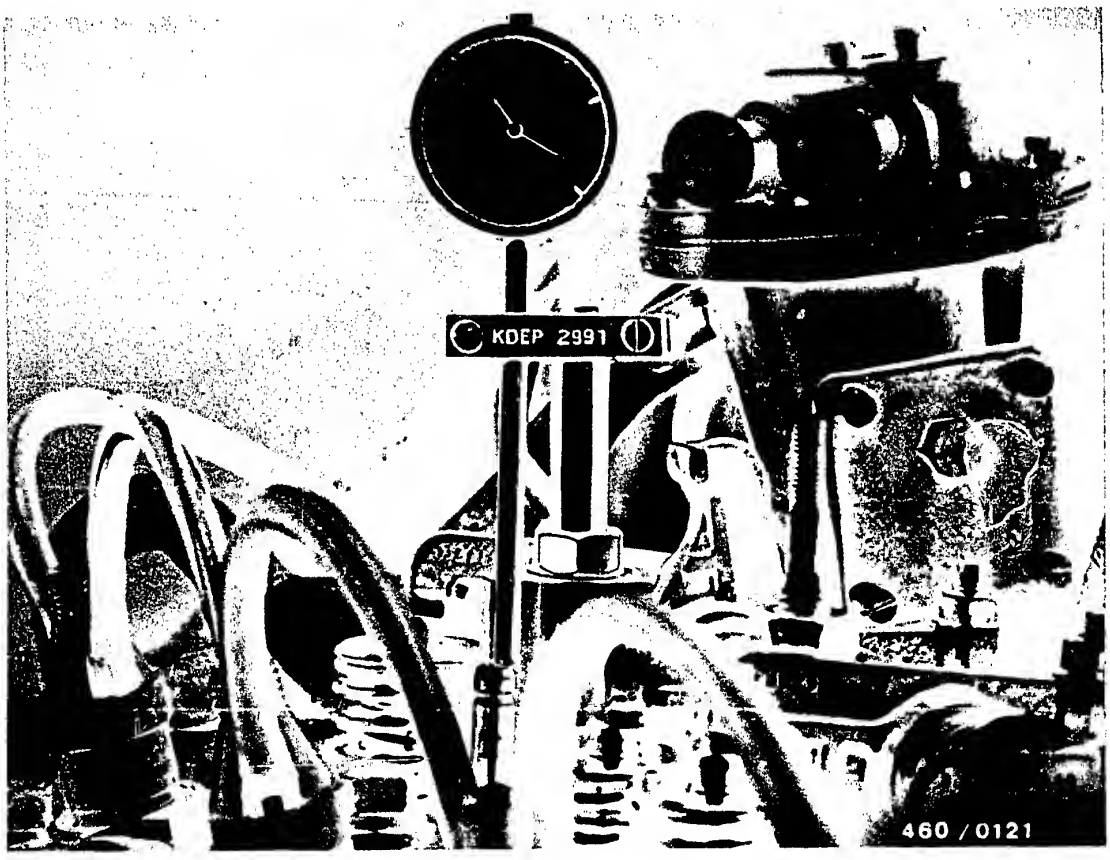
Using tool 8.0105 Y, press the valve spring of the 4th cylinder exhaust valve down. Remove the valve collets (1) from the exhaust valve.

Relax the valve spring, take the spring plate (2) and the valve spring (3) off the valve stem.



The 4th cylinder exhaust valve now lies against the engine piston.

Remove the sheathed-element glow plugs for the 3rd and 4th cylinders (arrows).



Screw measuring tool KDEP 2991 on the threaded bolt of the 4th cylinder.

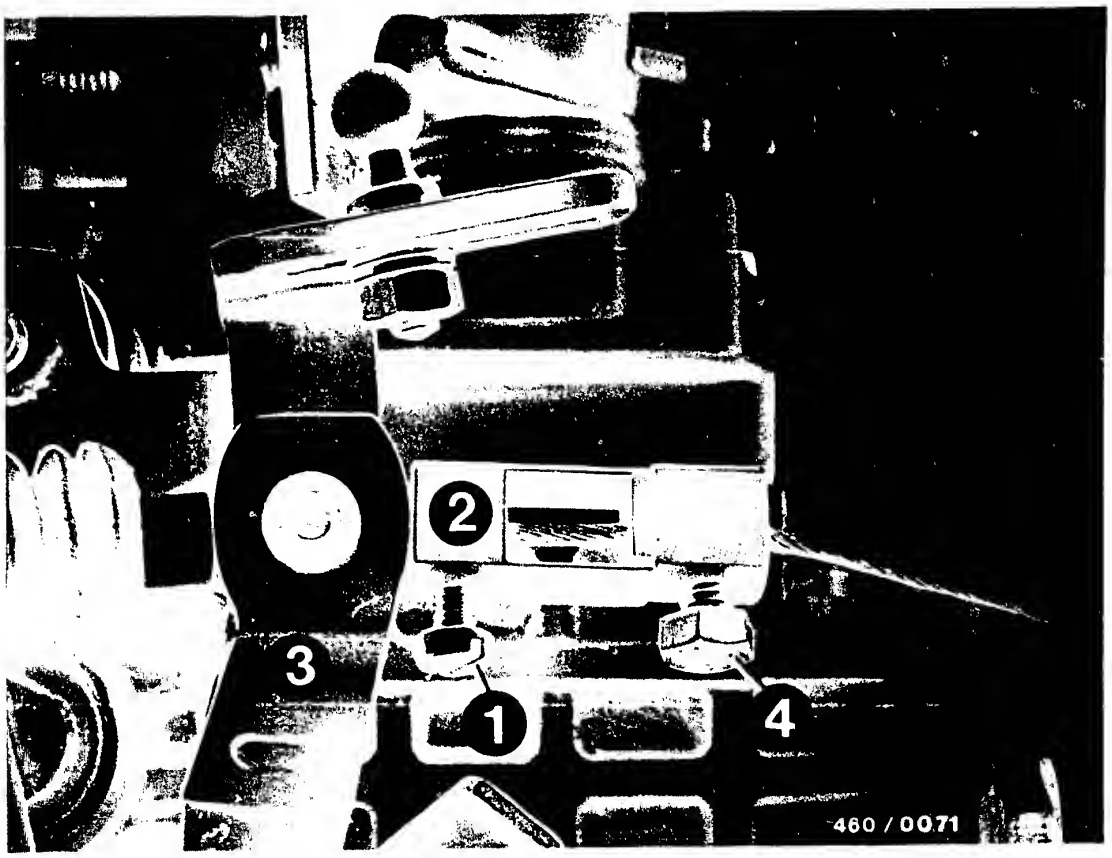
Clamp dial indicator 1 687 233 012 with the long measuring base into measuring tool KDEP 2991.

The measuring base lies on the exhaust valve of the 4th cylinder.

Prestress the dial indicator approx. 10 mm.

Turn the crankshaft counter to the direction of engine rotation until the plunger has made a stroke of approx. 7 mm.

Turn the crankshaft back in the direction of engine rotation to the TDC position of the 4th cylinder. Set the dial indicator at "0".



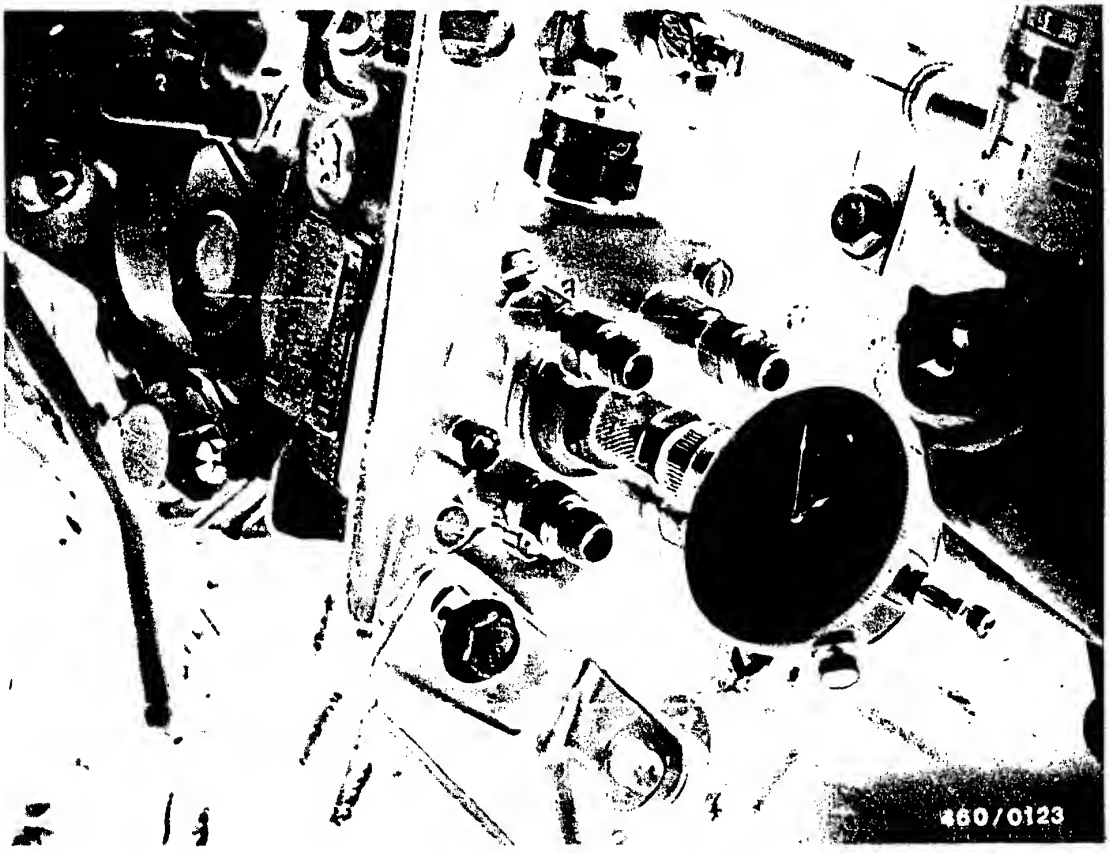
XD 3 T - 2.5 l engine only

To test and adjust the start of fuel delivery, the temperature-controlled cold-start accelerator (KSB) must be in its zero position.

For this, release the clamping screw (1) on the fuel-injection pump. Pull the spacer piece (2) and the control lever (3) toward the hydraulic head.

Turn the spacer piece (2) by 90° and shove it back toward the drive shaft until the control lever (3) lies up against the stop bracket.
In this position, the control device is switched off.

Note:
Do not release the locking screw (4) or a readjustment of the control device will be required.



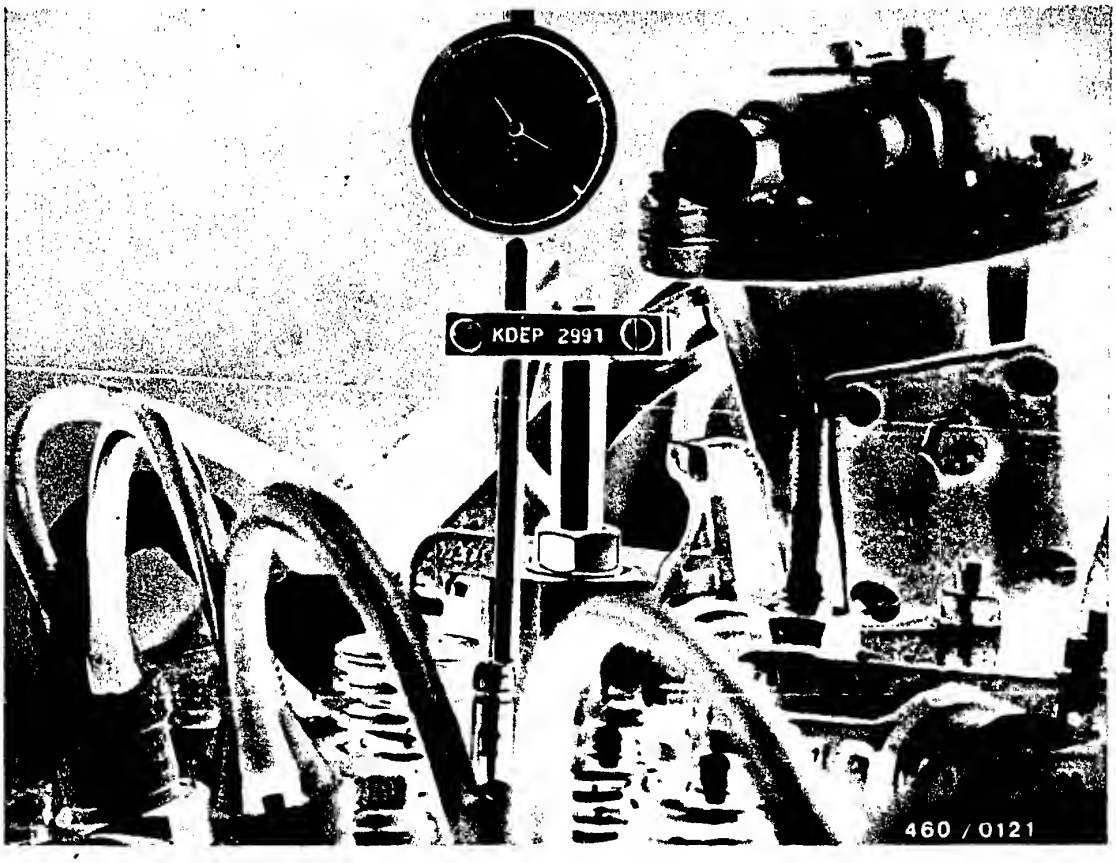
Remove the fuel-injection lines. (Prevent the delivery valve holders from becoming loose by holding them with a wrench).

Remove the bleeder screw from the central screw plug (triangular screw) of the fuel-injection pump.

Screw measuring tool KDEP 1085 into the hole for the bleeder screw.

Put on dial indicator 1 687 233 011 or .. 012 with the measuring base, and prestress it approx. 3 mm.

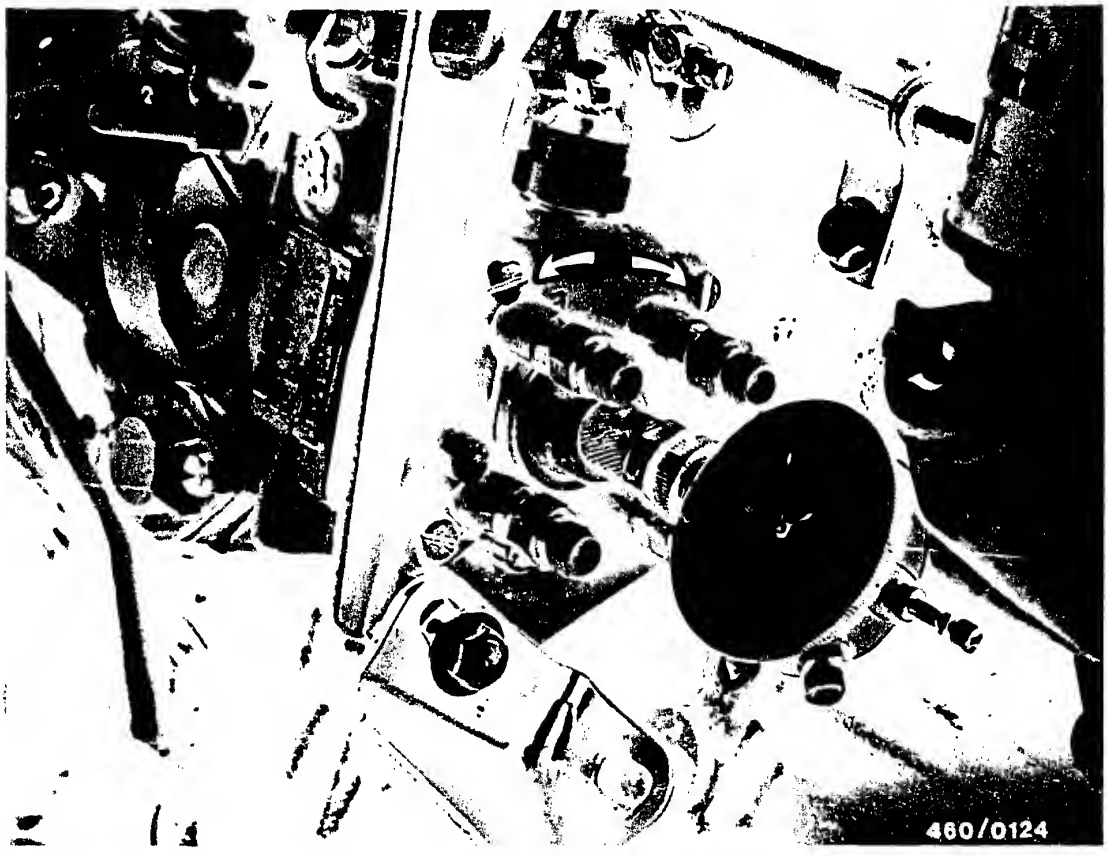
Turn the crankshaft counter to the direction of engine rotation until the dial indicator indicates the BDC of the fuel-injection pump plunger. Set the dial indicator at "0".



Turn the crankshaft in the direction of engine rotation until the dial indicator on the exhaust valve of the 4th cylinder indicates a piston stroke of

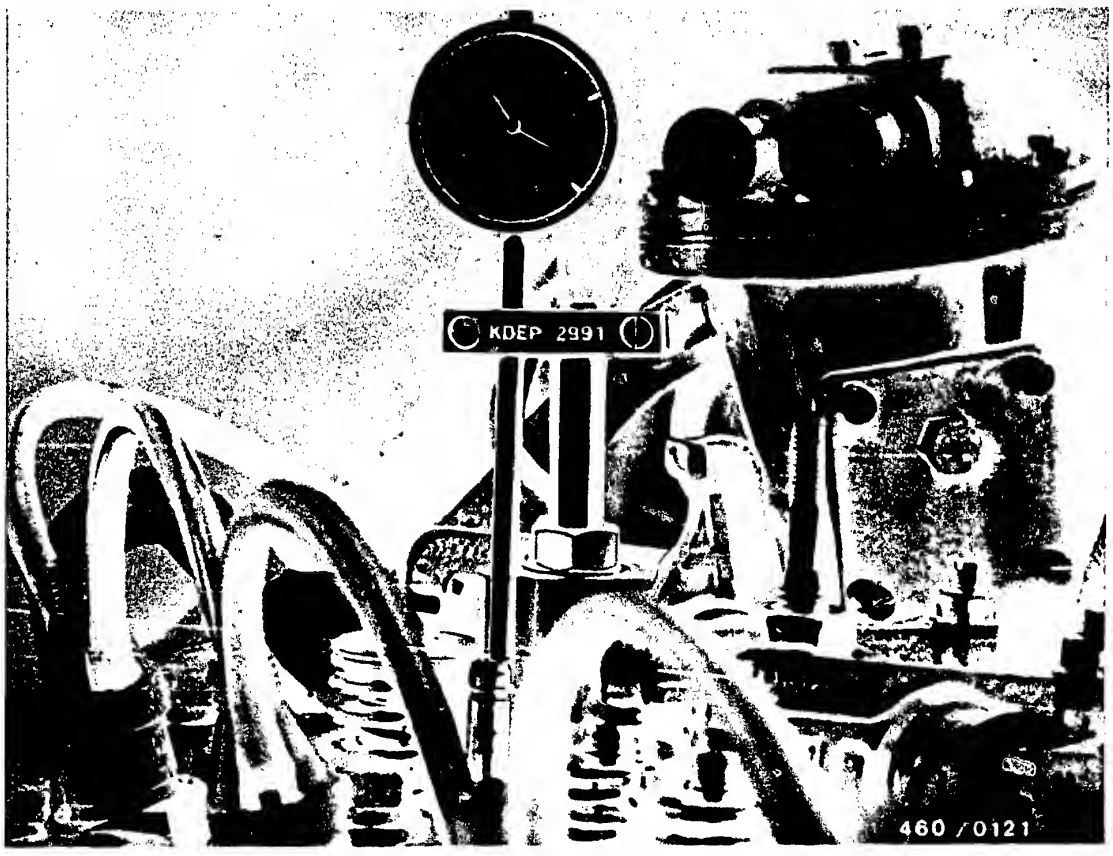
505/604 D-Turbo Engine XD 2S - 2.3 l Automatic	0.51 mm
505/604 D-Turbo Engine XD 3T - 2.5 l	0.89 mm
505/604 D-Turbo Engine XD 3T - 2.5 l Automatic	0.57 mm

before TDC.



With the piston settings as indicated, the dial indicator on the fuel-injection pump must indicate a pump plunger stroke of 0.48...0.52 mm ABDC.

If need be, adjust the stroke by pivoting fuel-injection pump. To do this, the fastening screws on the fuel-injection must be released.
(Loosen injection-pump fastening screws also on support bracket.)
Then retighten the fastening screws to 20 Nm.

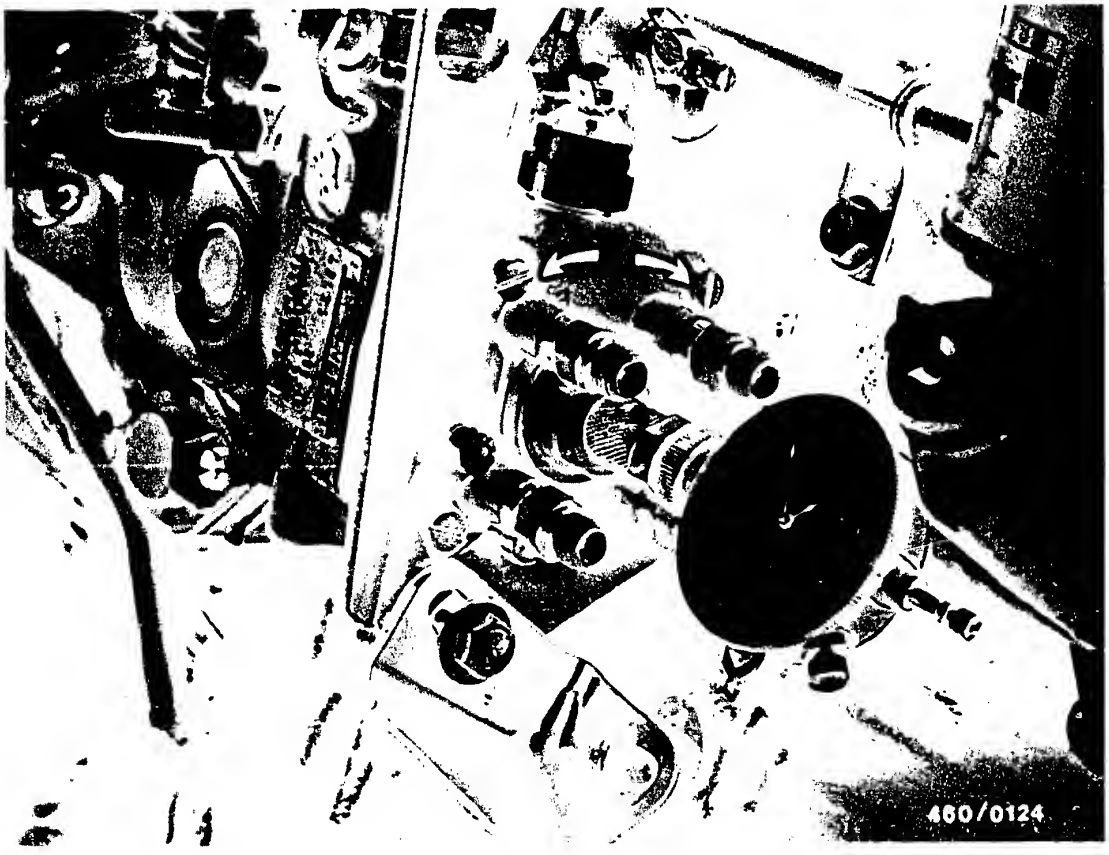


Checking adjustment of the fuel-injection pump to the engine

Turn the engine crankshaft in the direction of engine rotation as far as the TDC position for the 4th cylinder.

Check the 0 position of the dial gauge on the indicator exhaust valve.

Turn the crankshaft counter to the direction of engine rotation until the dial indicator shows the stroke of approx. 7 mm (7 turns of the needle).

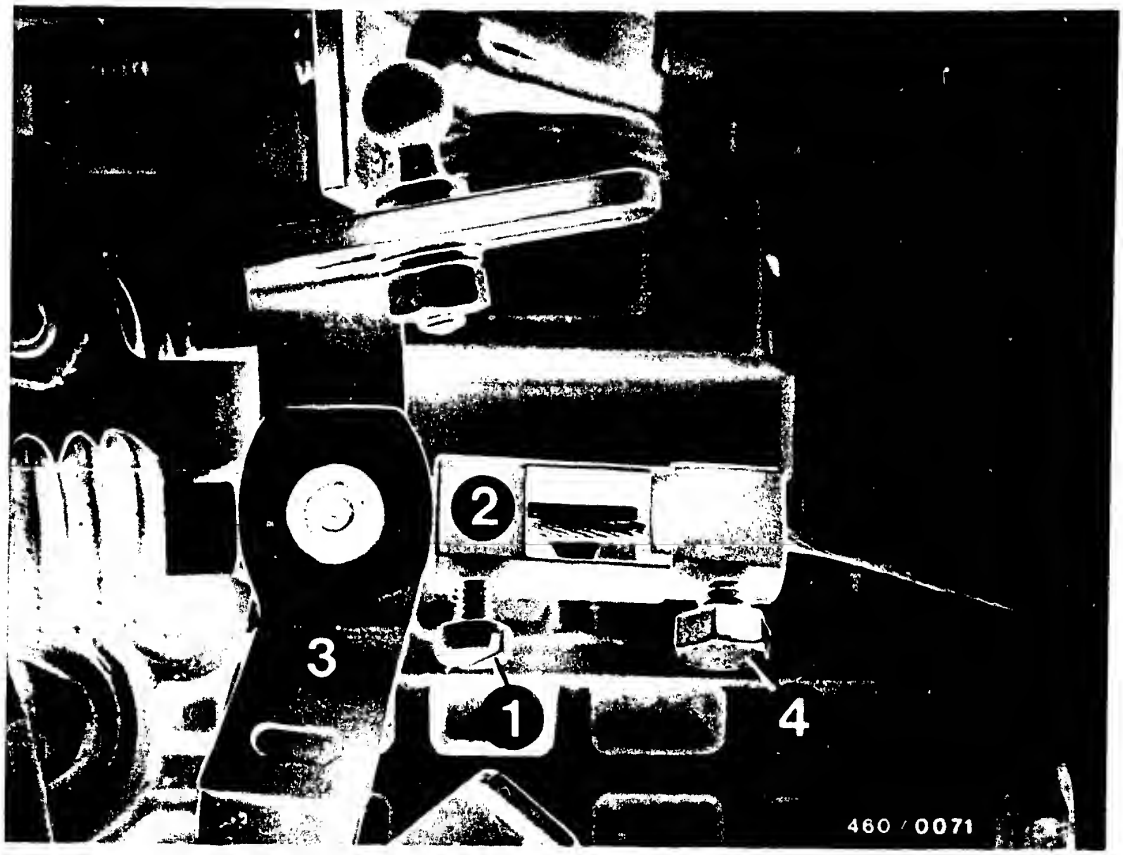


Turn the crankshaft in the direction of engine rotation until the dial indicator on the fuel-injection pump shows a stroke of 0.50 mm.

In this setting, the piston of the 4th cylinder must be

505/604 D-Turbo Engine XD 2S - 2.3 l Automatic	0.49...0.53 mm
505/604 D-Turbo Engine XD 3T - 2.5 l	0.87...0.91 mm
505/604 D-Turbo Engine XD 3T - 2.5 l Automatic	0.55...0.59 mm

before TDC.



XD 3 T - 2.5 l engine only

Pull the control lever (3) and the spacer piece (2) toward the hydraulic head.

Turn the spacer piece (2) by 90° and shove it back toward the drive shaft.

The spacer piece is in its initial position.

Tighten the clamping screw (1).

Note:
Do not release the locking screw (4) or a readjustment of the control device will be required.

Remove measuring tool KDEP 1085 and the dial indicator from the fuel-injection pump.

Put the bleeder screw on using a new copper gasket ring.

Bring the engine piston of the 4th cylinder into the TDC position. Remove measuring tool KDEP 2991 and the dial indicator. Put the valve spring and the upper spring plate on the 4th cylinder exhaust valve.

Using tool 8.0105 Y, press the valve spring down. While doing so, put in the exhaust valve collets. Relax the valve spring.

Turn the crankshaft so that the 1st cylinder exhaust valve just opens with the piston at BDC.

Press the valve spring of the 4th cylinder exhaust valve down using the spring plate.

Shove the rocker arm against the spring of the rocker arm shaft and put it into a horizontal position. In that position, guide the rocker arm on to the exhaust valve and tappet.

Remove tool 8.0105 Y.

Check valve clearance

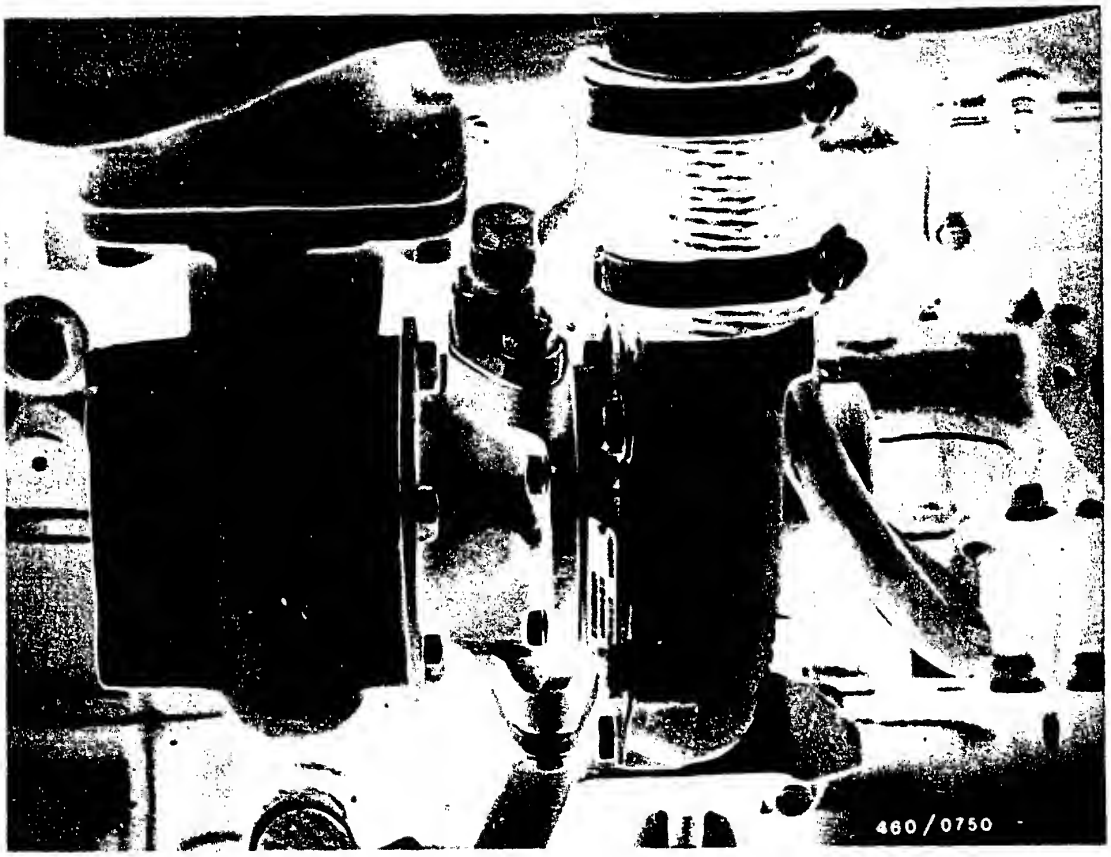
Check valve clearance only with engine cold. (min. 6 hrs. at rest)

Inlet valve:	0.15 mm
Exhaust valve:	0.25 mm

Put on the cylinder head cover, the fan funnel, and the line from the oil cooler to the oil filter.

Put in the sheathed-element glow plugs for the 3rd and 4th cylinders. Put on the fuel-injection lines. (Prevent the delivery valve holders from turning by holding them with a wrench.)

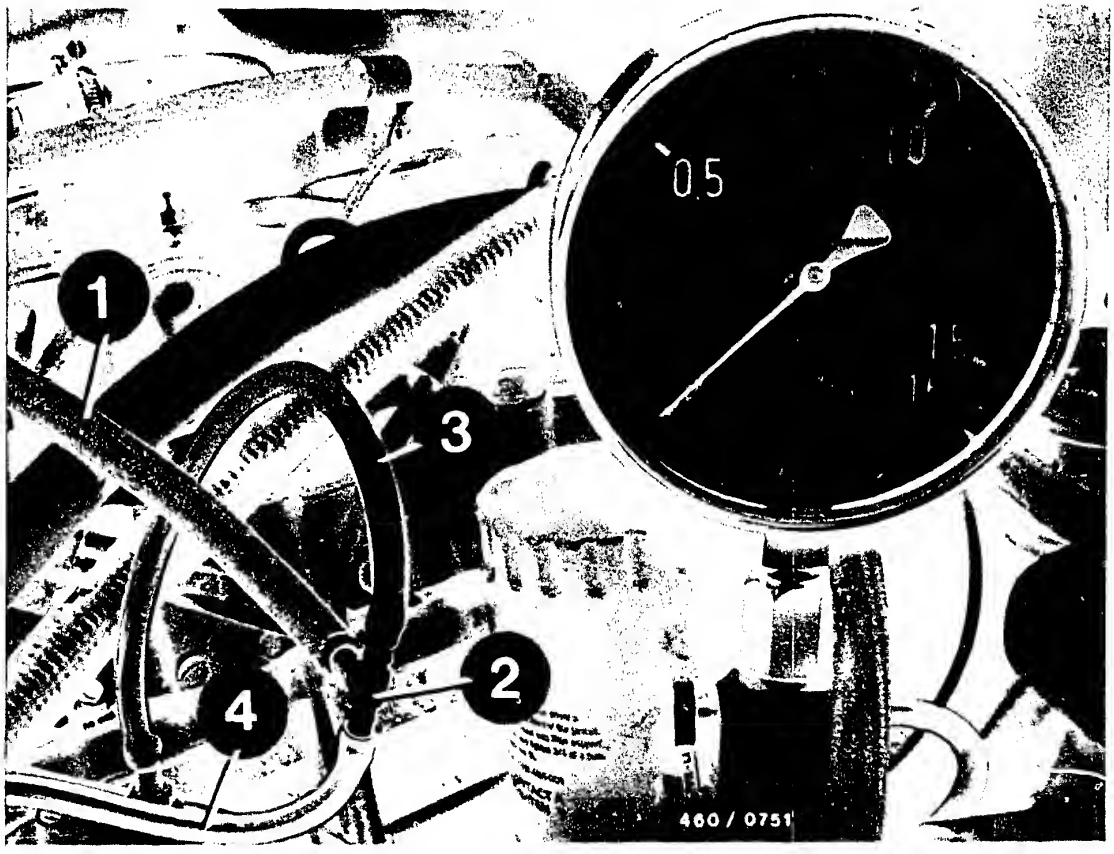
If need be, bleed the fuel-injection system.



36. Test charge-air pressure

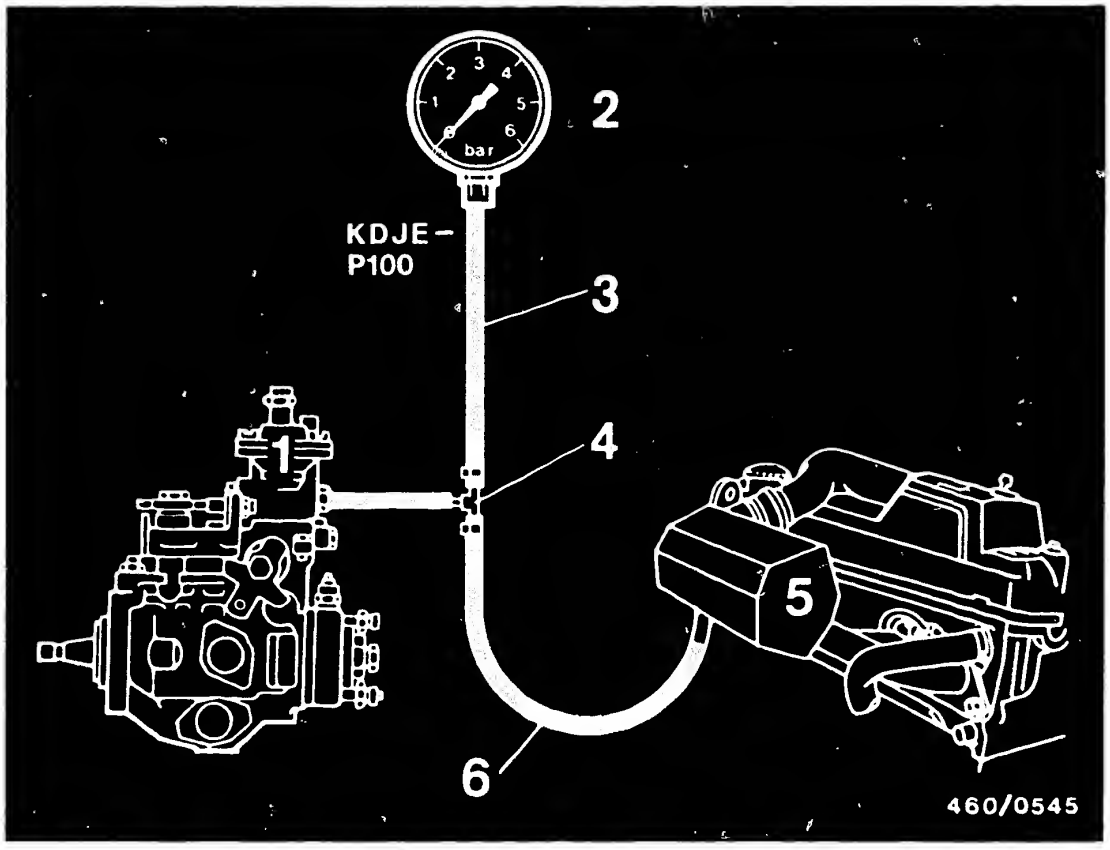
When working on the turbocharger, remember that even very small particles of dirt can cause destruction of the charger.

For that reason, never run the engine without an air filter.



1 = Connection hose
2 = Tee
3 = Commercially available hose
4 = Connection hose

To check the charge-air pressure, pressure tester KDJE-P 100, or a 0 ... 1.6 bar pressure gauge (e.g., Wika No. 4184) can be used (Figure).



1 = Manifold-pressure compensator (LDA) on injection pump
2 = Pressure tester
3 = Connection hose
4 = T-piece
5 = Charge-air pipe
6 = Commercially available hose

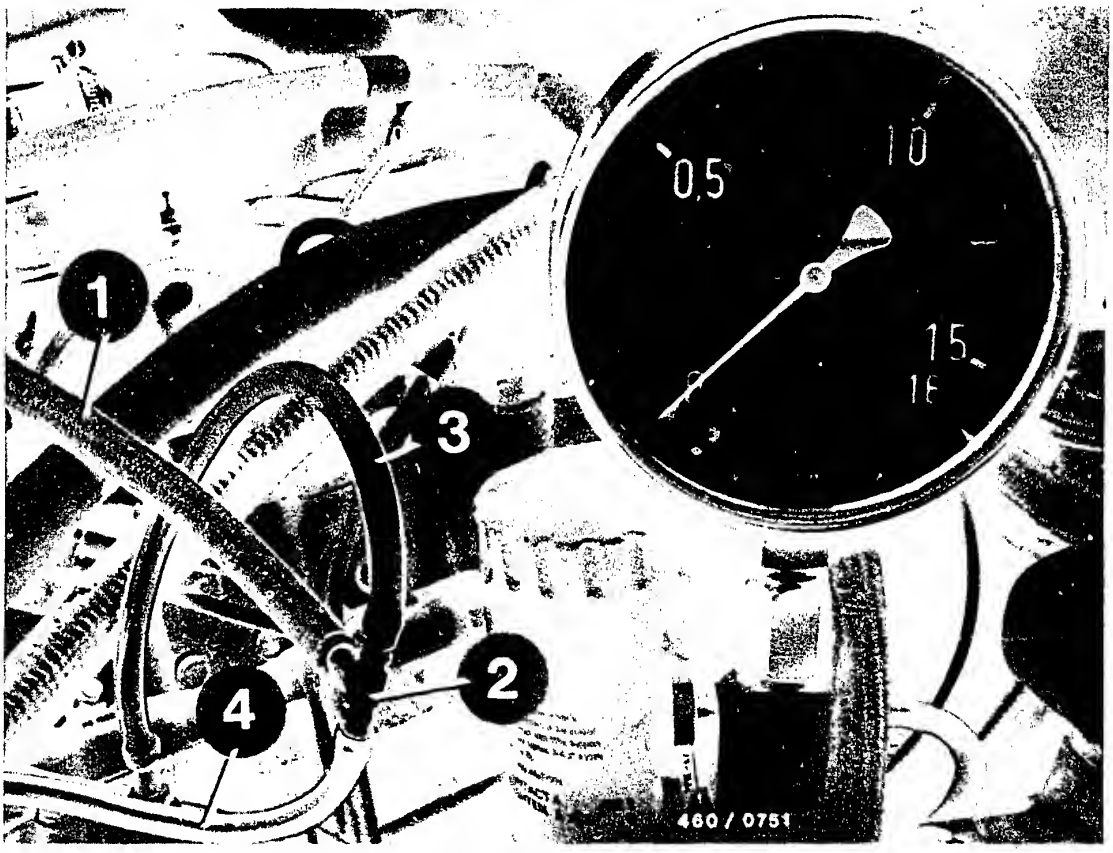
36.1.1 Mounting pressure tester KDJE-P 100

Disconnect connecting hose between charge-air pipe and manifold-pressure compensator of injection pump from charge-air pipe.

Plug on T-piece.

Establish connection to charge-air pipe using commercially available hose.

Connect connection hose of pressure tester to T-piece.



1 = Connecting hose
2 = T-piece
3 = Commercially available hose
4 = Connection hose

36.1.2 Mounting pressure gauge for measuring charge-air pressure

Disconnect connecting hose between charge-air pipe and manifold-pressure compensator of injection pump.

Plug on T-piece.

Using commercially available hose, establish connection to manifold-pressure compensator.

Plug connection hose of pressure gauge on to T-piece.

36.2 Measurement of charge-air pressure

The charge-air pressure is measured at standstill or on the chassis dynamometer.

- At standstill

  Engine speed 4800 min^{-1}

  Charge-air pressure 0.4...0.6 bar (XD2S-2.3 l eng.)
  Charge-air pressure 0.6...0.8 bar (XD3T-2.5 l eng.)

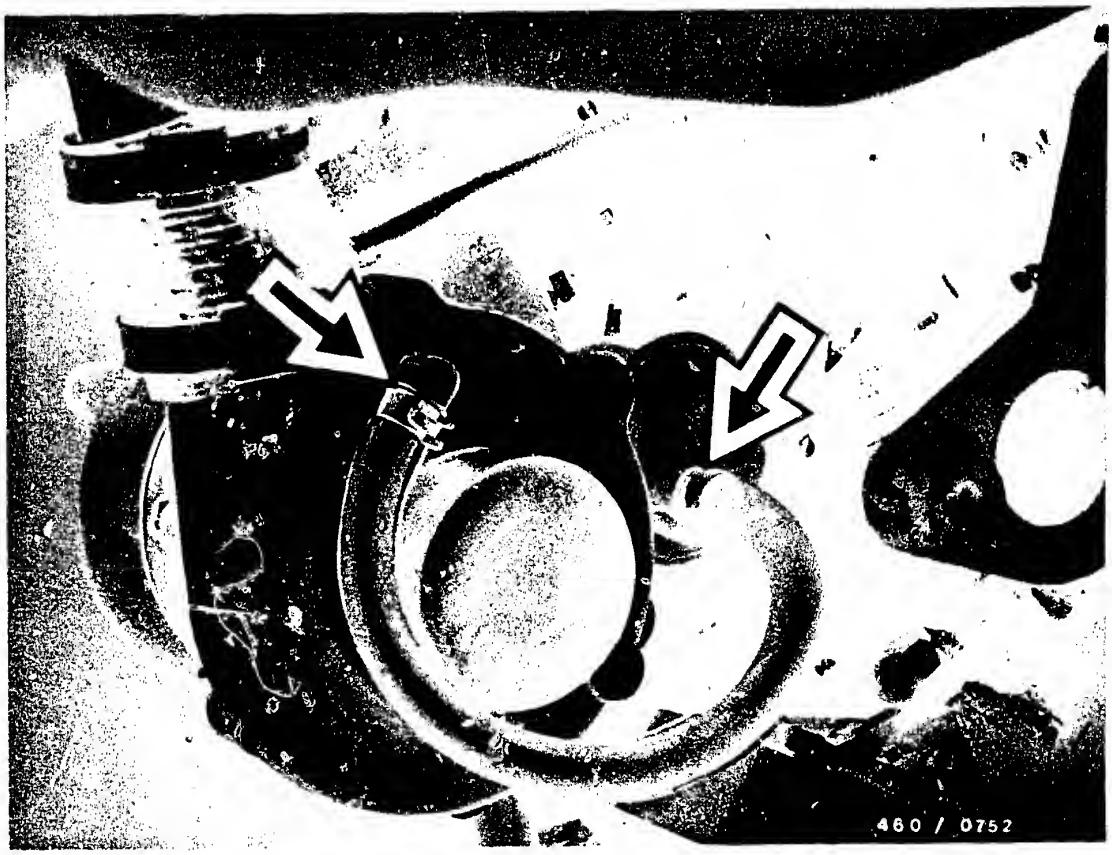
- On the chassis dynamometer

  Starting from 2000 min^{-1} at full load

  Charge-air pressure 0.4...0.6 bar (XD2S-2.3 l eng.)
  Charge-air pressure 0.6...0.8 bar (XD3T-2.5 l eng.)

Note:

In order to evaluate the exhaust gas turbocharger, it is necessary that the start of fuel delivery and the nozzle opening pressure be correctly adjusted, that there be no leaks on the intake or exhaust ends, and that the mechanical condition of the engine (valve clearance, compression pressure) be in order.



36.2.1 Charge-air pressure too high

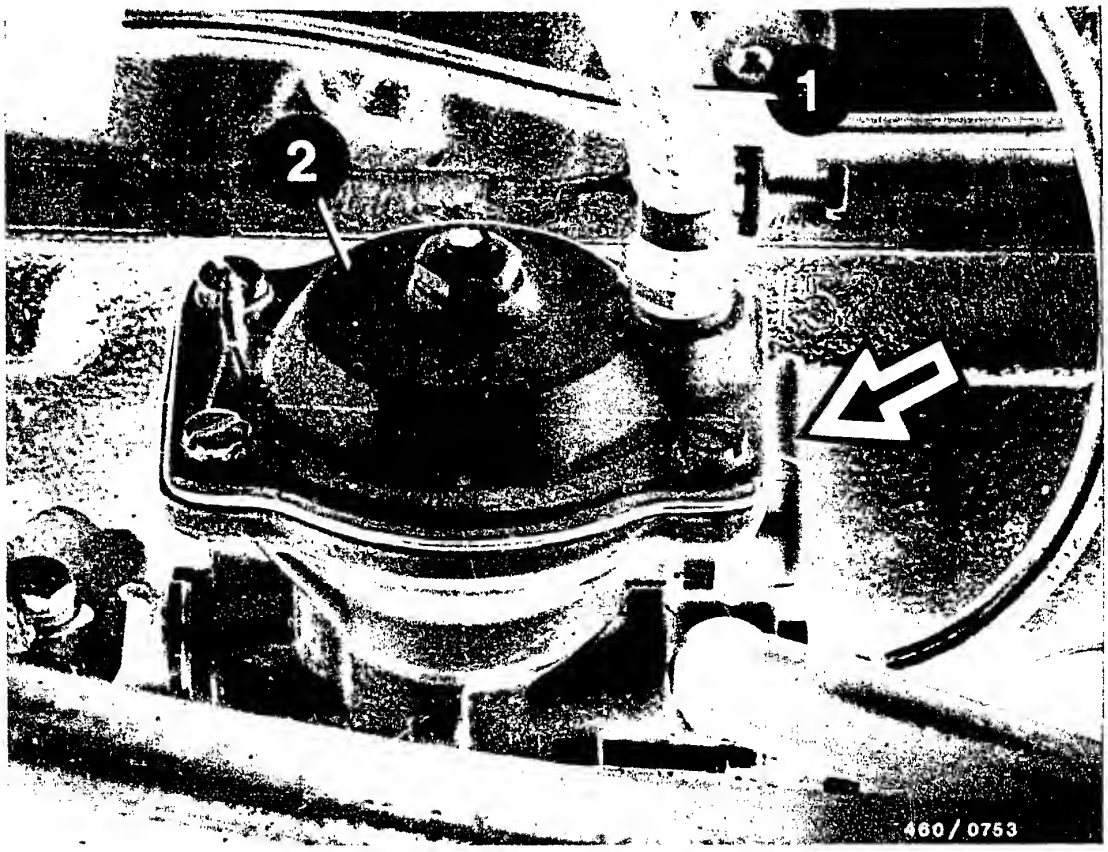
Cause of too high charge-air pressure:

- Line to the wastegate loose or defective (arrows).
- Diaphragm in the wastegate defective (*).
- Wastegate valve has seized, closed (*).
- Wastegate valve incorrectly adjusted (*).

* = Take out and replace the exhaust gas turbocharger.

Note:

After putting in a new exhaust gas turbocharger, fill the charger with oil and run the engine for approx. 1 minute at idle so that the oil supply to the charger is assured.

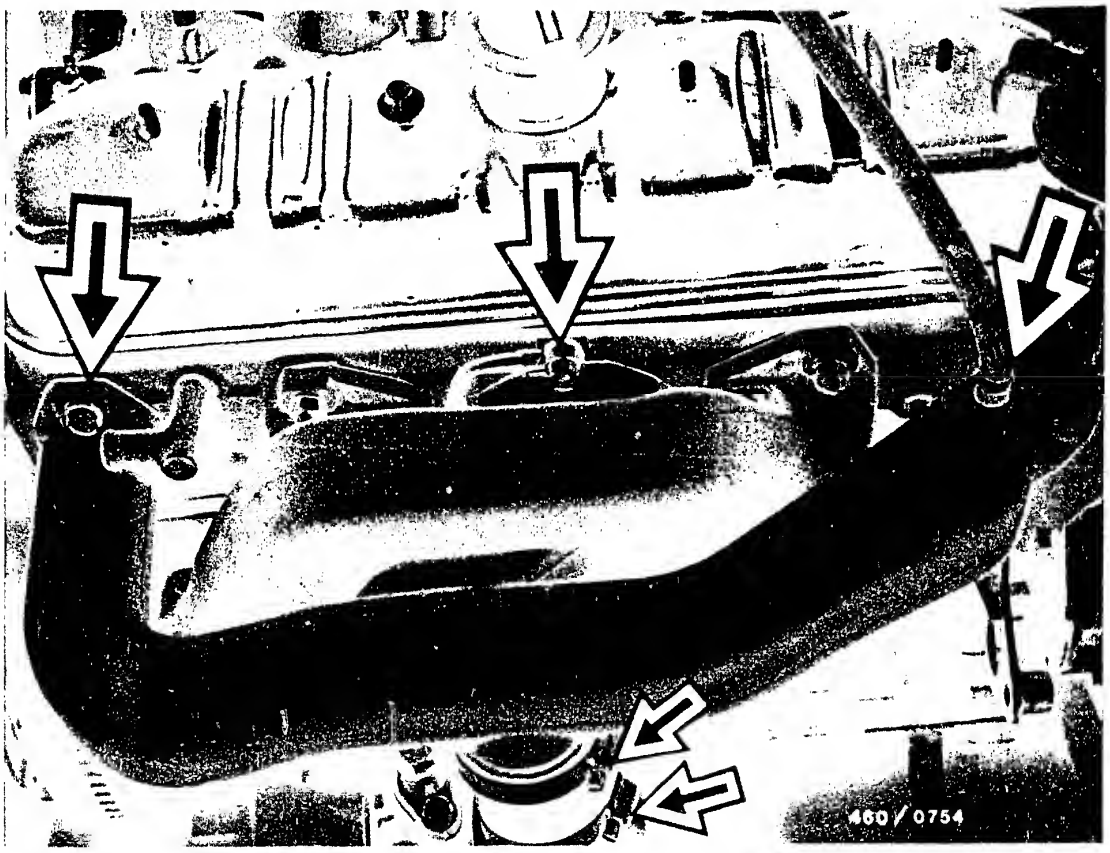


36.2.2 Charge-air pressure too low

If the charge-air pressure is too low, check the following points for leaks:

- Connecting hose (1) between the charge-air pipe and the manifold-pressure compensator (fuel-injection pump).
- Air line on the manifold-pressure compensator (arrow) may be clogged.

  Diaphragm in the manifold-pressure compensator (2) (LDA).



- Gasket between the charge-air pipe and the engine block (see Figure, arrows at top).
- Connecting hose between the compressor outlet and the charge-air pipe (arrows at bottom).
- Additional causes for too low charge-air pressure:
- Air filter (dirty).
- Wastegate, incorrectly set *.
- Turbine shaft tends to seize.
- Exhaust system clogged.

* = Take out and replace exhaust gas turbocharger.

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